



Draft Work Plan for Enhanced Evaporation Pilot Test

**Anaconda Mine Site
Yerington, Nevada**



Report Prepared by:

Singatse Peak Services, LLC
517 W. Bridge Street
Yerington, Nevada 89447

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Work Plan for Enhanced Evaporation Pilot Test - Draft Yerington Anaconda Mine Site

Table of Contents

1.0	Introduction	3
2.0	Project Team	3
3.0	Summary of OU8 Components	4
4.0	Objectives of Pilot Test	6
5.0	Legal Agreements.....	7
6.0	Technical Considerations	7
7.0	Pilot Test Design.....	8
8.0	Construction.....	11
9.0	Startup and Operation	12
10.0	Health & Safety	14
11.0	Schedule.....	15
12.0	References	16

List of Tables

- 3-1 Arimetco FMS Pond Design Specifications
- 7-1 Summary of Issues Identified in the SRK Evaporation Study

List of Figures

- 3-1 FMS Components
- 7-1 Sprinkler Irrigation Pilot Test Location
- 7-2 Water Truck Pilot Test Location
- 11-1 Schedule for Pilot Test Implementation

List of Appendices

- A. Pump Curves
- B. Spray Irrigation Heads – Senninger and Nelson
- C. Specmeter Soil Sensors
- D. FMS Pond Elevation vs. Capacity Curves

1.0 Introduction

This work plan provides the details of SPS's proposed enhanced evaporation pilot test to provide an opportunity to increase the available capacity of the fluid management pond components of the Anaconda Mine Site OU8 Fluid Management System (FMS). Under the terms of 2007 and 2009 EPA Orders (USEPA, 2007, 2009), Atlantic Richfield Company (ARC) currently performs operations and maintenance (O&M) of the system and prepares monthly and annual monitoring reports.

The volume of drain-down solutions has significantly decreased since Arimetco operations ceased in 1999, as of 2014 averaging less than 10 gpm. Even with the reduced volume of drain-down solutions, it is estimated that existing FMS ponds may run out of capacity by 2019.

SRK, Inc. under contract to SPS completed an FMS Study that, among other things, recommended enhanced evaporation as a method to extend the life of the FMS (SRK, 2013). Commenters to the SRK Study recommended a pilot test to confirm the efficacy of enhanced evaporation at the site.

Recent discussions between EPA/NDEP/ARC/SPS regarding a State-lead approach to overall site closure began in early 2015. As part of these discussions, SPS voluntarily offered to perform an enhanced evaporation pilot test to increase the capacity of the FMS ponds which would provide additional time to secure private funding to close the orphan OU8. SPS offers this work plan in furtherance of its voluntary offer to assist in finding alternatives to federal funding of the closure of OU8. SPS performing the pilot test field work is conditioned upon receipt of appropriate agreements. If the results of the evaporation pilot test are successful, the capacity of the FMS could be extended by several years, providing additional time to secure private funding to close OU8 while also evaluating restarting mining at the site.

2.0 Project Team

Singatse Peak Services, LLC (SPS) will take the lead role in planning, designing, constructing and operating the enhanced evaporation pilot test. All work will be coordinated with EPA, NDEP and ARC and prior to the start of the pilot test this work plan will be reviewed by these parties. SPS will work with a local contractor to assist in building and operating the pilot test.

During the pilot test, ARC will continue to operate the FMS except for SPS's removal of fluids from specified FMS ponds to feed the enhanced evaporation system.

3.0 Summary of OU8 Components

This section of the work plan summarizes key components of OU8 and the FMS. This information was summarized from various reports associated with OU8 (Brown & Caldwell, 2010a, 2010b and 2015).

Fluid Management System (FMS) Components - The main components of the FMS are shown in Figure 3-1, and described below:

- Five lined Heap Leach Pads (HLPs) and perimeter collection ditches;
- Six HLP drain-down collection ponds
- Approximately 25,000 feet of piping and transfer pumps;
- Five FMS Evaporation Ponds
- Evaporative sprinkler system on the Phase IV Vat Leach Tailings (VLT) HLP which is used as an emergency backup in the event pond levels exceed operational levels;
- Electrical power supply system;
- Various flow measurement devices, and
- Eight pressure transducers on the FMS Ponds.

A key component of the FMS is the six ponds that collect drain down fluids from the HLPs. The characteristics of each pond are summarized in Table 3-1 (copied from Brown & Caldwell, 2015). The total capacity of the ponds listed in Table 3-1 is approximately 10.8 million gallons. Table 2-1 does not include capacity for the FMS Evaporation Pond (i.e., the EPA 4-Acre Pond) because this pond is filled with mineral salt precipitates and has limited fluid storage capacity.

Table 3-1. Arimetco FMS Pond Design Specifications (from Brown & Caldwell, 2015)								
Description	Slot 2 Pond	Slot Sed Pond	Phase I/II Pond	VLT Pond ²	VLT Sed Pond	Evap. Pond B	Evap. Pond C	Total
Crest Area (square feet)	44,384	6,681	15,368	44,400	~9,000	46,854	46,854	297,514
Crest Area (acre)	0.97	0.15	0.35	1.02	~0.21	1.07	1.07	4.84
Total Depth (feet)	22	6	8	18	NA	8.8	8.8	NA
Operational Maximum Water Depth (feet)	20	4	6	13	NA	6.8	6.8	NA
Maximum Operational Capacity (million gallons)	3.1	0.14	0.43	1.9	0.053	1.7	1.7	9.0
Operational High Water Freeboard (feet)	1	1	1	2.5	2.5	1	1	NA
Operational High Water Depth (feet)	21	5	7	15.5	NA	7.8	7.8	NA
Highest Operational Capacity (acre-feet)	10.4	0.61	1.53	7.98	~0.16	6.13	6.13	32.9
Highest Operational Capacity (million gallons)	3.4	0.2	0.5	2.6	~0.053	2.0	2.0	10.8
Primary Drain-Down Source(s)	Slot HLP	Slot HLP & leak detector	Phase I HLP	VLT HLP & Leak Detector	VLT HLP	Phase III HLP	Phase III HLP	NA

NA = Not applicable

¹ Operational water level increased from eight to nine feet by EPA (Letter entitled "Approval of Operational Level Increase, Anaconda Yerington Mine Site/Arimetco Fluid Management System (FMS)," dated January 11, 2012).

² VLT Pond storage capacity and surface area shown are after liner replacement.

FMS Conveyance - Many of the FMS components were in place during Arimetco operations.

Modifications by NDEP and EPA since 2000 have improved system performance, eliminated areas with the potential for drain-down solutions to escape containment, and increased the storage and evaporation capacity. If needed for emergency operations, solutions can be pumped from the VLT Pond to the top of the Phase IV VLT HLP for evaporation.

The pumps employed for fluid management at various ponds in 2014 are summarized in Table 3-2 (Brown & Caldwell, 2015). Pumping rates are expressed as gallons per minute (gpm). Pump curves are provided in Appendix A. After evaluating the pump curves, it is possible that one or more of the pumps could be used for the pilot test. ARC will select the pump(s) to be used in the enhanced evaporation pilot test, and will coordinate this request with ARC. Potential modifications to plumbing and or/electrical systems made by SPS will be documented prior to the start of the test.

Table 3-2. Arimetco FMS Pump Information (from Brown & Caldwell, 2015)				
Location	Discharge Pipeline Diameter (inches)	Pump Manufacturer	Pump Size (horse power)	Measured Pumping Rate (gpm)
Slot Sediment Pond (SSP) ¹	8	Durco	25	250
VLT Sediment Pond Backup Pump ¹	4	Durco	15	200
VLT Storage Pond Diesel Pump ²	4	Godwin	40	300

¹ Pumping rate in gallons per minute (gpm) was calculated based on pump horsepower, static head, and minor pipeline loss.

² Variable frequency drive pump adjusted to maintain maximum 300 gpm flow. The pump will also be utilized for pumping the Phase I Pond fluid.

FMS Flow and Pond Level Measuring Instruments - The Slot Pond weir uses a data collector of fluid elevation behind a weir to measure flow. In-pipe volumetric weirs with bubble flow meters are used on the 16-inch diameter inflow lines to measure flows from the Phase III HLPs to FMS Evaporation Ponds B and C, and to the VLT Pond. The instrumentation on the weirs records data at one-minute intervals. Pressure transducers record data at 30-minute intervals. Pressure transducers with data loggers are also used to monitor fluid levels in the FMS ponds. SPS or ARC will continue collecting pond level, pump flow rates and pipe flow rates data during the pilot test.

Contingency Operations – The contingency plan, as approved by EPA and NDEP, includes pumping fluids into the VLT pond which has additional capacity if the fluids are allowed to back up onto the double lined VLT HLP. From the VLT pond, fluids can be pumped to the top of the Phase IV VLT HLP for enhanced evaporation through a sprinkler system attached to four-inch distribution lines on top of the HLP. It is not anticipated that contingency operations will need to be deployed during operation of the pilot test. SPS will coordinate with ARC, EPA and NDEP in the event conditions warrant initiating emergency operations.

4.0 Objectives of Pilot Test

Enhanced evaporation is used to manage excess solutions in the mining industry across the western US and in many parts of the world. The primary objective of the pilot test at OU8 is to obtain empirical data to design a full-scale evaporation system to extend the life of the FMS ponds by several years. A specific estimate of extension of the FMS capacity will be determined from data collected during the pilot test.

SPS will test two sprinkler types over a range of fluid application rates to achieve optimum evaporation while preventing re-circulation of excess fluids back to the HLP liner. SPS also will test use of a water truck to spray fluids on top of selected HLPs during the pilot test.

Soil monitoring probes will be installed below the test areas to monitor moisture content and to determine the optimum fluid application rate that will not result in fluids reporting back to the HLP liners

A key component of the pilot test will be to understand how to minimize solids build up and clogging of sprinkler heads and to assess the O&M required for mitigating this problem. There have been significant improvements in sprinkler head design over the past decade to alleviate this issue.

5.0 Legal Agreements

SPS requires an appropriate and comprehensive agreement with NDEP to address liability issues that third parties or the agencies could attempt to attach to SPS. SPS voluntarily offered to assist NDEP, EPA, ARC and the community on resolving the OU8 unfunded closure costs. This voluntary offer should not be met with liability. SPS was willing to prepare this work plan without such an agreement in place. However, SPS will not commence field work until such an agreement has been executed.

6.0 Technical Considerations

Technologies Considered - SPS reviewed several alternatives for enhanced evaporation. Technologies considered included irrigation (using sprinklers, wobblers or drip emitters), a water truck, and mechanical evaporators. The pilot test will evaluate two types of sprinkler heads and the water truck approach.

Irrigation Methods – During irrigation, fluids are pumped through a system of pipes to the sprinkler heads. At each sprinkler head, the fluid is sprayed into the air through a nozzle that breaks the fluid into small droplets which fall to the ground surface. The pump system, sprinklers and operating conditions are designed to uniformly apply water to the soil. This is accomplished by distribution lines that are connected to a manifold piping system at pre-determined spacing. The sprinkler heads are installed in the manifold so that the fluid is applied at a set spacing between the sprinkler heads and header lines. Spacing depends on the application rate and substrate size, gradation and type. For the enhanced evaporation pilot test, spacing will be optimized to achieve maximum evaporation.

Three types of irrigation heads were considered for the enhanced evaporation pilot test.

- Traditional sprinkler heads use physical or mechanical action to break the fluid stream into fine particles or mist. The smaller size droplets yield higher evaporation rates. The two types of sprinkler heads to be considered for the pilot test are made by Senninger Irrigation, Inc.

(Superspray) and Nelson Irrigation, Inc (Rotator R3000). Data sheets and performance specifications of these sprinkler heads are included in Appendix B. Other types of sprinkler heads and nozzles are available and may be tested as part of the pilot test, depending on performance.

- Wobblers are designed to minimize evaporation (as is preferred in heap leach and agricultural applications) and this design was not considered for enhanced evaporation.
- Drip emitters are also designed to minimize evaporative losses and runoff and this design was not considered for enhanced evaporation.

7.0 Pilot Test Design

Previous Work by SRK - SRK completed conceptual design work during the FMS Study (SRK, 2013). The design included drip irrigation panels installed on the top of a HLP, where draindown solution from the FMS ponds would be pumped to the drip panels on a rotating basis at a relatively low rate. SRK planned to start with approximately 1 gallon/square foot/day (approximately equivalent to an irrigation rate of 1.67 inches/day) and then modify the rate depending on the initial results. The combination of low rate fluid application and rotating the panels would allow the solution to evaporate during the peak evaporation period of May through October. The proposed design of the panels was to evaporate fluids in the upper two feet of the HLPs with no incidental fluid reaching the liner. The initial size and number of panels were to be updated as operational data were collected during the first year of data collection. The additional benefit of this system is that much of the precipitating sludge is deposited on top of the HLP rather than building up in the lined FMS ponds.

Comments received from the EPA, NDEP and other stakeholders on the SRK design are summarized in Table 7-1, along with the mitigation to each issue. Several commenters suggested running a pilot test to verify the performance of enhanced evaporation. The proposed pilot test addresses this concern. SPS has agreed to operate the enhanced evaporation pilot conditional upon entering into appropriate agreements as discussed in Section 5.

Table 7-1. Summary of Issues Identified in the SRK Evaporation Study

Issue	Mitigation
Fluid application rate and performance	Perform pilot test
Clogging of nozzles/sprinklers	Address in pilot test; test various head types, daily O&M
Blinding of HLP surface	Mechanical tillage, if/as needed
Overspray	Shut down during excessive wind
Precipitate creates dust on HLPs	Shown not to create dust (Pond A)
Accessibility to top of HLPs	Improve existing access roads
Stability of HLPs	No change to loading of the HLPs is anticipated as a result of the evaporation pilot. If needed, stability analyses will be performed as part of full-scale design
Operatorship of evaporation system	SPS has agreed to operate the pilot test, conditional on Agreements in place

Sprinkler Irrigation System Design - The first step for design and layout of the evaporation pilot is to determine the optimum rate of fluid application on the surface of the HLP. This process will start with a low rate of 0.5 in/day. The sprinkler head design is selected to cover the specified area with a given flow rate in gallons per minute (gpm). The piping and pump sizes are selected to apply the desired flow rate at the design pressure. Given that these performance specifications are typically provided by the manufacturer using water, the rates are estimates that consider the high TDS (and therefore higher specific gravity) of the FMS solutions.

For the pilot test, a mid-range sprinkler head size was selected with the nozzle orifice sized to achieve 5 gpm at a pressure of approximately 40 psi. The pilot test will start with 4 panels with dimensions of approximately 90 ft wide by 150 ft long, or 13,500 ft² (0.3 acres). For the initial operation, the desired radius of coverage is 15 ft (30 ft diameter) at each sprinkler head. Each 90 x 150 ft panel will include 15 heads for a design application rate of 75 gpm/panel. It is expected two panels will be operated at the same time resulting in 150 gpm. To achieve this rate, the panels will be operated initially for 56 minutes (approximately 1 hr) daily resulting in approximately 0.5 inches of application each day followed by an appropriate resting period to allow for near-surface evaporation to occur. Four panels will be built at the start of the pilot for a total daily application rate of 18,000 gal/day. For a 4-month pilot test, five days/week, the total fluid application is estimated to be approximately 1.15 million gallons. This volume assumes 80% uptime to account for weather and other unplanned downtime of the system.

The irrigation test is planned on the top of the Slot HLP (Figure 7-1). Figure 7-1 also shows the location of the pump, piping to the top of the HLP, flow meter and the manifold to the 4 panels.

The existing piping configuration on the top of the VLT HLP will be also be evaluated for possible use during the pilot. If the VLT HLP were to be used during the pilot test, modifications to the piping would include installing risers and sprinkler heads to evenly distribute fluids on the surface of the HLP.

For improved uniformity of fluid application at the surface, pressure regulators may be installed upstream of the sprinkler heads. Pressure regulators in sprinkler system design are typically used to stabilize a varying inlet pressure to a constant outlet pressure, regardless of changes in the system pressure due to hydraulic conditions, elevation changes, and pumping scenarios. This will in turn create a more uniform rate of water application, controlled sprinkler performance (droplet size and throw distance), and flexibility in overall system operation.

Based on preliminary discussions with ARC, the plan is to use one of the existing pumps for the pilot test with the understanding that short term use for the pilot test will not affect other needs of the pumps for regular O&M. Either the portable Godwin diesel powered pump or the existing 25 horsepower Durco electric pump are planned to be used for the pilot test. The pump curves are provided in Appendix A and show that adequate pump rates and pressures can be accomplished using either pump for the pilot test.

Water Truck Design – For the water truck approach, a plastic tank will be fitted with a manifold at the side of the truck to apply fluids. Side discharge was selected to eliminate tracking of fluids or precipitate outside the limits of lined areas of the site. The manifold will be designed such that fluids will be evenly spread from one side of the truck. The speed of the truck and rate of application are key variables that affect the amount of fluid to be applied. The application areas on top of the both HLPs will be designed in a pattern that will allow the truck to maintain forward motion without driving on areas of applied fluids.

The discharge nozzle on the truck will be manufactured from stainless steel to minimize effects from low pH fluids and corrosion. The nozzle will be sized to provide coverage of 50 to 60 ft perpendicular to the direction of truck travel.

The panels for the water truck test are proposed to be located on the Phase III South and Phase III 4X HLPs. Each panel is estimated to be approximately 5 acres as shown in Figure 7-2. For planning purposes, it is estimated that 4 loads at 3,000 gal each, will be applied each day, resulting in 12,000 gal/day over 10 acres. The water truck approach would be run for a period of several weeks to test the concept. If the concept is shown to have potential, the duration of the pilot may be extended. As with the sprinkler approach, the number of loads and acreage will be adjusted during the pilot test to

optimize performance while preventing over application resulting in circulation of applied fluids to the HLP liner system.

Performance Monitoring - During the pilot test, daily operations will be performed as fluids are applied to the evaporation panels. Fluid application rates (i.e. flow rates) will be monitored and adjusted to prevent circulation of excess fluids back onto the HLP liners.

To assist with evaluation of the amount of fluid that is being evaporated and retained in the upper few feet of the HLP, soil moisture sensors will be placed at two depths beneath each evaporation panel. The sensors will be placed at a depth of 1.5 and 3 ft, which is estimated to be within the evaporation zone of the HLP surface. The soil moisture sensor proposed for use during the pilot is manufactured by Spectrum Technologies, Inc. Specifications. Installation procedures for the moisture sensors are included in Appendix C.

Fluid volumes applied to the HLPs will be estimated by the using pond elevation/capacity curves for each pond. These curves are provided in Appendix D. Routine flow measurements will be continued for each of the FMS ponds. In addition, the pumping volumes will also be estimated using pump run times and the pump curves. Along with the soil moisture data, these flow data will be compared to the precipitation data collected from the two on-site meteorological stations to verify that applied fluids are not recirculated back to the HLP liners.

8.0 Construction

The initial construction step is to provide for improved access to test locations at the top of HLPs. Each test location will then be surveyed and staked according to the specifications discussed in Section 7.0. Each test area will be leveled with a dozer to prevent potential run off of applied fluids. A small perimeter berm will be constructed, also using a dozer, around the test areas to further prevent run off from the test locations.

Irrigation Approach - For the sprinkler irrigation approach, the piping and sprinkler layout to be constructed at the top of the Slot HLP is shown in Figure 7-1. At the pump location adjacent to the Slot HLP, a liner will be placed outside of the area of the perimeter ditch around the Slot HLP so that potential leakage outside the lined HLP will be on containment.

The main header pipe to pump fluid from the Slot Pond to the top of the Slot HLP will be 4 inch HDPE pipe, with welded seams. At the top of the HLP, the header pipe will be reduced to 3 inch HDPE pipe to create the irrigation manifold. A 1 inch HDPE riser pipe will be used to attach the sprinkler heads to the manifold pipe. Valves will be located on the header and manifold pipe so that adjustments to the

number of sprinklers to be operated at one time can be varied. The valves will also provide flexibility to perform maintenance at selected sprinkler heads without having to shut down the entire system.

As discussed above, the pump selected for the pilot irrigation test is anticipated to be either the existing 25 horsepower electric pump located at the slot pond or the portable diesel powered pump. The pump discharge piping will be modified to connect to the irrigation header and manifold system. For the pilot, the current O&M system pumping configuration will be maintained whereby fluids are pumped from the slot pond into the slot sediment pond using the existing small electric pump.

The existing piping layout on the top of the VLT HLP will be evaluated for possible use during the pilot test. This location has several advantages over the slot HLP location since the piping and pump are already in place (Figure 3). If the VLT HLP were to be used during the pilot test, modifications to the piping would include installing risers and sprinkler heads to evenly apply fluids on the surface of the HLP. The decision to use the Slot or the VLT HLP location will be made prior to finalize the start of construction based on discussions with the contractor selected to perform the pilot.

Water Truck Approach - For the water truck approach, the pilot test will be located on top of the Phase III South and Phase III 4X HLPs (Figure 7-2). The fluids for the water truck approach will be sourced from either Pond A, Pond B or the VLT pond. A portable pump will be used to load the truck. As with the irrigation approach, the pump and all piping not already over the pond liner will be placed on a liner to be constructed at the load out area(s).

The application areas on top of the both HLPs will be constructed in a pattern that will allow the truck to maintain forward motion without driving on areas of applied fluids.

9.0 Startup and Operation

During the pilot test, an adaptive management approach will be used to achieve the goals of the test. Adaptive management starts by predicting the performance based on best judgement or previous experience, designing and implementing the alternative, monitoring to assess and understand performance, and then use the early results to adjust the operations. This will be an iterative approach to optimize the design and performance of the evaporation pilot test which will ultimately be used to design a full scale system.

Irrigation Startup and Operations – Startup of the pilot irrigation system will begin with pressure testing the piping with clean water to identify leaks. Leaks will be repaired prior to charging the system with FMS solutions.

Prior to initiating pumping each day, the operator at the bottom of the HLP will start the pump and be in radio communication with a spotter located at the top of the slot HLP to observe sprinkler operation. The appropriate valves will be opened (and closed) to charge two panels at one time. The system will be run to observe performance and adjustments will be made as needed. The daily routine will include the following sequence:

- Check weather forecast
- Pre-start pump check
- Pre-start sprinkler system check
- Start pump, observe operation

Data to be collected will include weather (precipitation, cloud cover, temperature, humidity, wind speed and direction), flow rates, pump run time, and document issues or problems encountered. A daily checklist will be prepared and filled out by the operators.

Water Truck Start Up and Operations – Prior to testing the truck with FMS fluids, the operation will be tested using clean water. The initial testing will assure proper functioning of the various system components so that adjustments can be made prior to use on the HLPs. During the shakedown period, truck speed and flow rate will be adjusted to estimate the initial rates for FMS fluid use. Differences between clean water and FMS fluids are expected given the higher specific gravity (SG) of the FMS fluids.

Coordination with O&M Activities Performed by ARC - An important consideration during operation of the pilot test is coordination of ongoing O&M activities at OU8. ARC performs O&M following an O&M Plan prepared in 2010. O&M includes the following activities (ARC, 2015):

- Maintain and repair pond liners, anchor trenches and perimeter ditches;
- Conduct monthly monitoring of pond levels, inflow rates and pumping rates;
- Maintain leak detection systems and record leakage;
- Maintain flow meters, weir inflow level meters, and pond level transducers;
- Maintain EPA's bird deterrent system at the Arimetco FMS ponds
- Collect samples of drain-down solutions for lab analyses; and
- Report FMS activities and data including FMS solution transfer volumes, average drain-down rates and pond levels to EPA.

During the pilot test, ARC will continue to perform many of the O&M activities described above. However, SPS will take over responsibility for transferring fluids to the pilot test locations on top of the

HLPs. Any modifications to piping or electrical systems will be documented with P&IDs and as-built drawings so that they can be included in updates to the O&M Manual.

SPS also will be responsible for maintaining the fluid levels within the ponds at or below designated fluid levels. SPS also will prepare a stand-alone Data Summary Report (DSR) at the completion of the pilot test. The DSR will include all fluid flow and mass balance data suitable for use in updating the FMS water balance as part the 2016 Annual O&M report to be prepared by ARC.

Prior to construction of the pilot test, SPS and ARC will attend a joint work session with the current field operators and engineers of the FMS. The output from this meeting will be to document changes to O&M procedures that may be required during operation of the pilot test, including preparation of a detailed checklist that defines the roles and responsibilities of each party. This document will be prepared by SPS and agreed to by both parties prior to the start of the pilot test. This approach will ensure that all required O&M activities will be performed during the pilot test.

10.0 Health & Safety

All field activities will be conducted in accordance with SPS's Safety, Health, Security and Environmental (SHSE) Manual. Copies of the SHSE Manual are located at SPS's office and are available to all site workers. The SHSE Manual lists the requirements and procedure including:

- Safety and health risk or Job Safety Analysis (JSA)
- Employee training requirements;
- Personal protective equipment (PPE);
- Regular safety meetings;
- Site control measures and
- Emergency response.

Job Safety Analysis (JSA) – A Job Safety Analysis (JSA) is a risk management tool that SPS uses to identify hazards and risks associated with a specific task. Risk control can be accomplished through the use of engineering or administrative controls and the use of PPE. JSA's will be prepared for major tasks associated with the pilot test and will be completed prior to beginning of the task. JSA's also include potential environmental risks. The JSA's will be developed jointly by the field staff and contractors performing the work. JSAs are maintained at SPS's office and will be reviewed by site workers prior to and throughout the pilot test.

Other training includes OSHA 40-hour HAZWOER training and annual 8-hour Refresher as appropriate. Copies of OSHA and other training certificates will be maintained at the Site and in employee personnel records.

Personal Protective Equipment - Minimum PPE requirements required for the pilot test include the following:

- Hard hats;
- Safety glasses;
- Steel-toe boots;
- High-visibility, long sleeved shirts; and
- Leather work gloves.

Additional PPE may be required for specific work tasks and includes Tyvek coveralls, rubber boots, side shields on safety glasses and nitrile gloves when there is potential for contact with low pH solutions. Specific PPE requirements will be identified as part of the JSA discussed above.

11.0 Schedule

The schedule for the pilot test is shown in Figure 11-1. SPS will prepare and finalize the work plan in parallel with negotiating agreements with NDEP, EPA and ARC discussed in Section 5. SPS will begin procurement and construction after execution of the agreements.

Figure 11-1. Schedule for Pilot Test Implementation

Activity	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Draft Work Plan														
Agency Review														
Final Work Plan														
Agreements/Covenant not to sue														
Procurement														
Construction														
Startup														
Operations														
Draft Data Report														
Agency Review														
Final Report														

After the data report has been submitted to the Agencies and ARC, a decision will be made on whether to design and operate a full scale enhanced evaporation system. Details of the schedule for design,

construction and startup of the full scale system will be included in the data report. To optimize success, a full scale system should be in place and operational for the 2017 evaporation season in May 2017.

12.0 References

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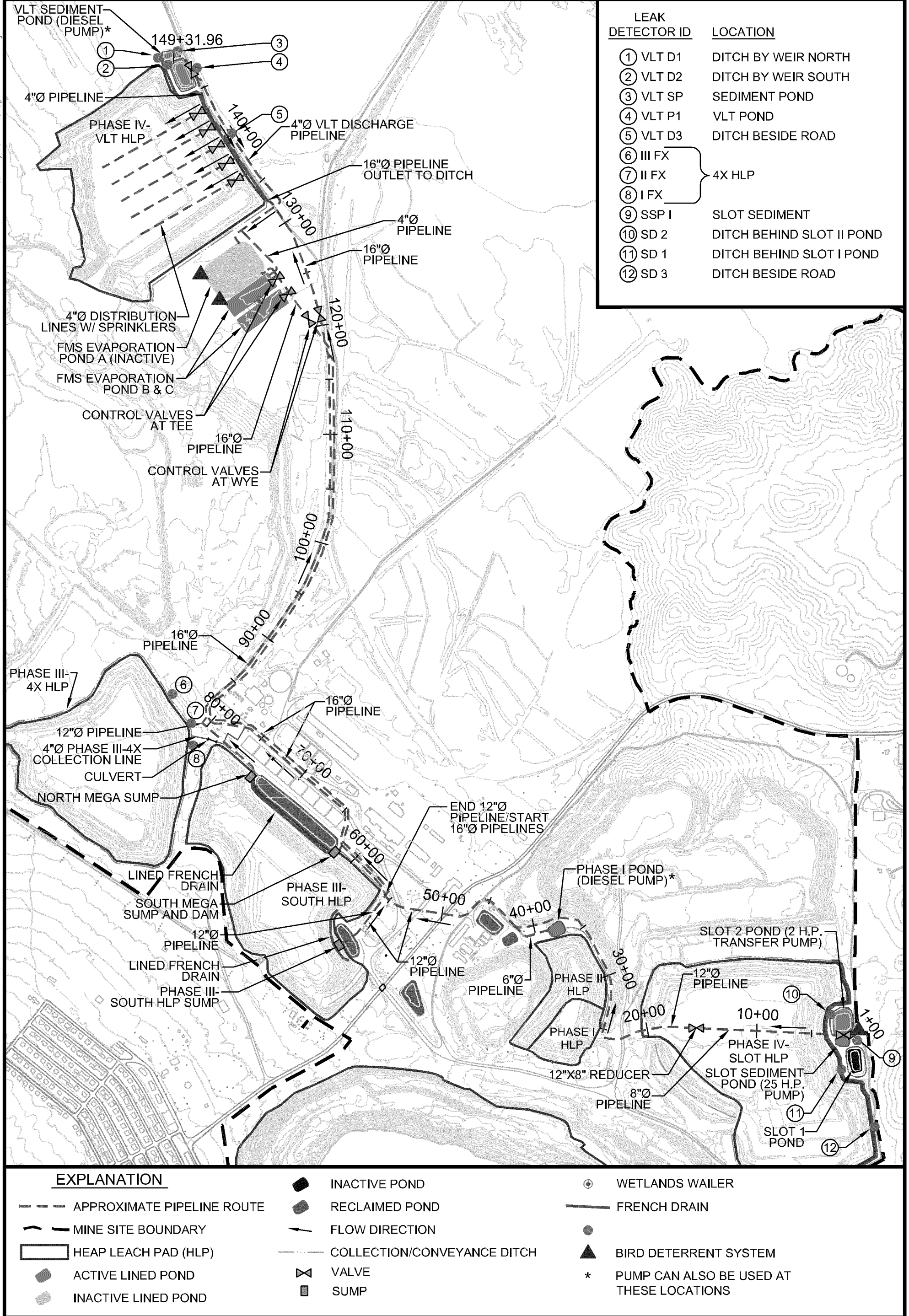
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Figures

rjohnson
Mar 24, 2014 - 2:15pm



**Figure 7-1. Sprinkler Irrigation Pilot Test Location
Slot Heap Leach Pad**

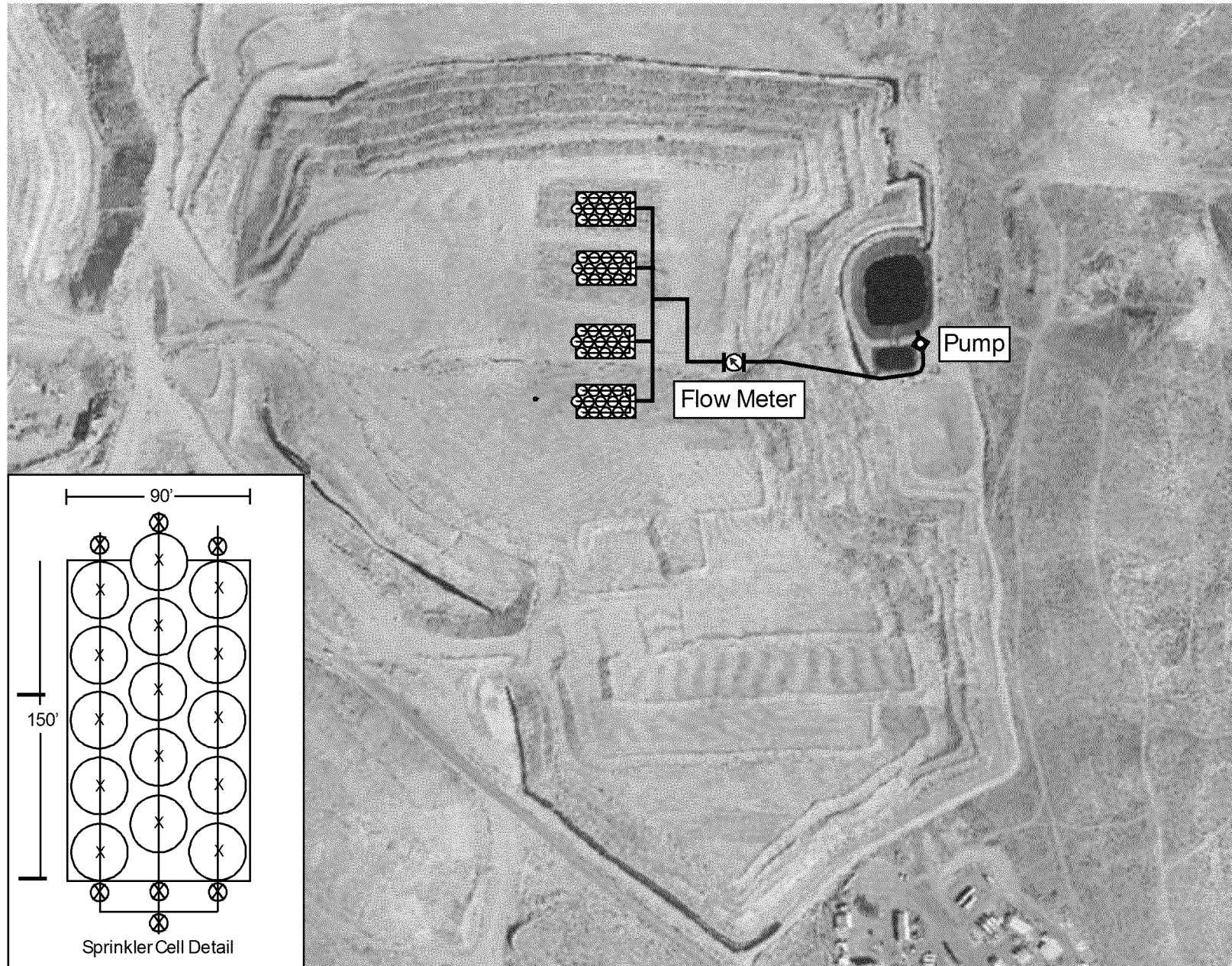
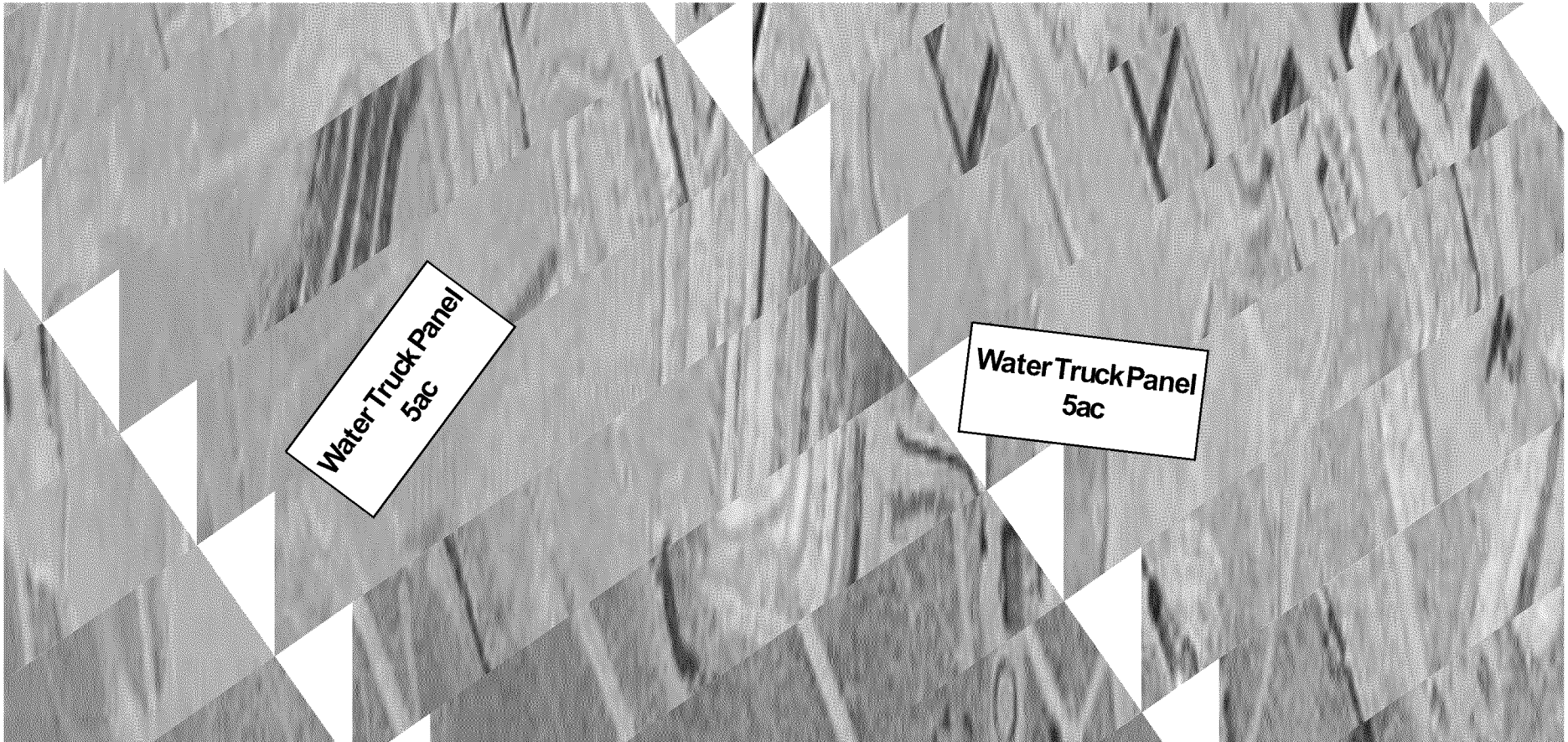


Figure 7-2. Water Truck Pilot Test Location
Phase III-4X, Phase III-South Heap Leach Pads



*Panel locations are conceptual and will be finalized based on field conditions.

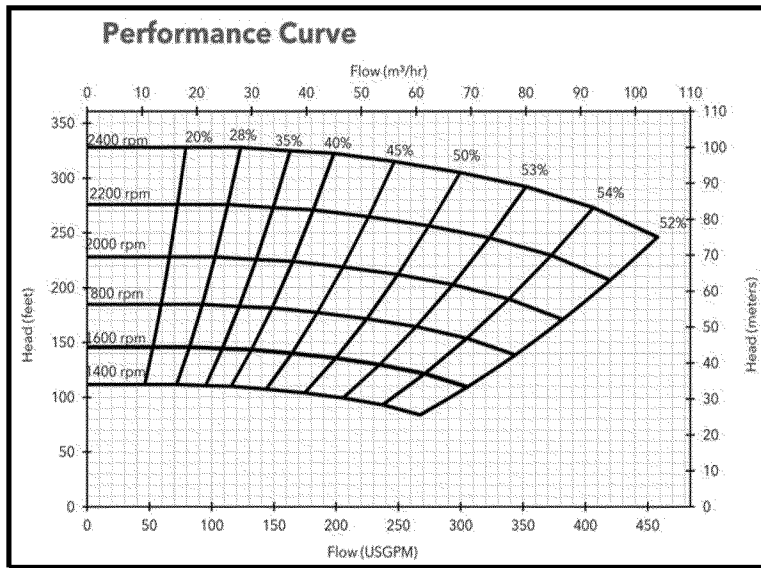
Appendices

- Appendix A** **Pump Curves**
- Appendix B.1** **Senninger Irrigation Specifications**
- Appendix B.2** **Nelson Irrigation Specifications**
- Appendix C** **Specmeter Soil Moisture Specifications**
- Appendix D** **FMS Pond Elevation vs. Capacity Curves**

Appendix A Pump Curves

Arimetco Fluid Management System Pump Configuration			
Location	Pump Manufacturer	Model	Pump Size (horse power)
Slot Sediment Pond (SSP)	Durco	MK3 STD. 3" x 2"	25
VLT Sediment Pond Backup Pump	Durco	MK3 STD. 3" x 2"	15
VLT Storage Pond Diesel Pump	Godwin	HL 80	40
Spare Pumps (Curve No. CN0497R01)	Goulds	8SHK6 2" x 2-1/2"-8	20

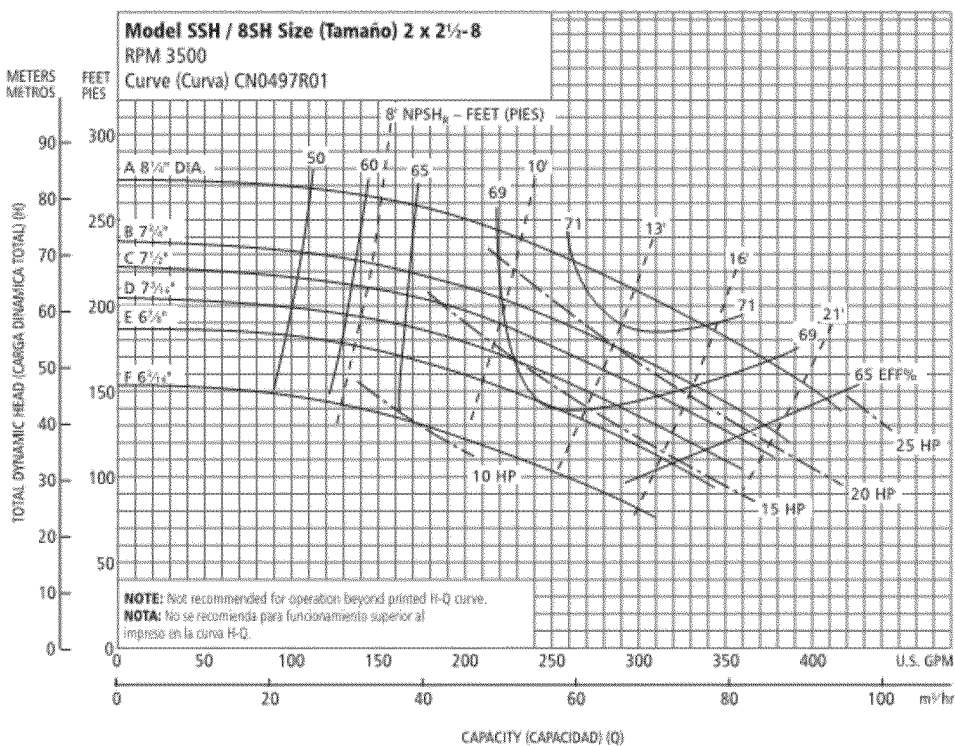
VLT Storage Pond Diesel Pump – Godwin HL 80



Q (gpm)	Performance Curve					
	Head (Feet)					
	1400 RPM	1600 RPM	1800 RPM	2000 RPM	2200 RPM	2400 RPM
0	110	145	185	230	275	330
50	109	144	184	229	274	329
100	108	143	183	228	273	328
150	107	142	182	227	272	327
200	100	135	175	222	267	322
250	89	124	166	213	259	315
300		110	153	200	250	305
350			135	182	237	293
400				160	217	275
450					190	250

Goulds 8SHK6 2 x 2-1/2 (20 HP) – 8 Curve No. CN0497R01 – Spare Pump

Performance Curves – 60 Hz, 3500 RPM Curvas de Funcionamiento – 60 Hz, 3500 RPM



Optional Impeller, Impulsor Opcional		
Impeller Code, Código del Impulsor	Dia., Diá.	Standard HP Rating, Estándar HP Potencia
A	8 1/4"	25
B	7 3/4"	20
C	7 1/2"	20
D	7 1/4"	15
E	6 3/4"	15
F	6 1/2"	10

NOTE: Pump will pass a sphere to 1/4" diameter.

NOTA: La bomba pasará una esfera a 1/4" diámetro.

Q (gpm)	Head (ft)
0	240
50	236
100	231
150	224
200	210
250	192
300	170
350	143
400	110

Durco Model MK3 STD. 3" x 2" – 15 HP located on VLT Sediment Pond

Durco Pump (Curve No. MIII834V)

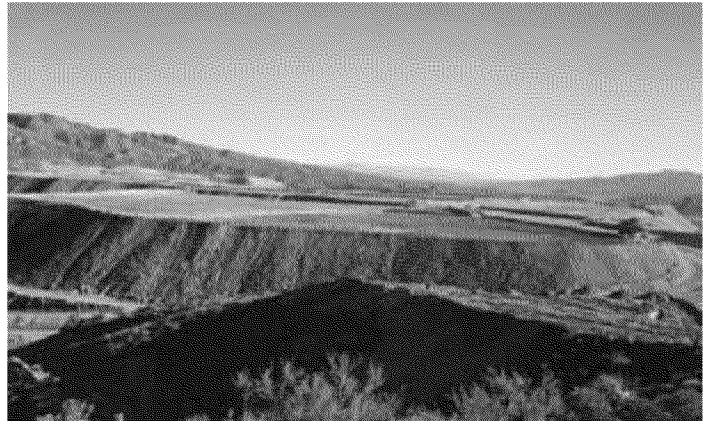
Q (gpm)	Head (ft)
0	200
40	198
80	197
100	196
140	191
180	181
200	175
240	160
280	145
300	135
340	108
380	82

Durco Model MK3 STD. 3" x 2" – 25 HP located on Slot Sediment Pond – Pump Curve developed by testing

Flow	Head (psi)	Head (feet)
0	101	233
180	100	231
330	94	217
360	92	213
410	88	203
460	84	194
500	80	185

Appendix B-1 Senninger Irrigation Specifications

SOLUTION mININg



Products for leach recovery of gold, silver and copper, dust suppression, solution evaporation, rinsing, and effluent solution dispersion.



www.senninger.com

Super Spray Sprays

INTROduced IN 1981



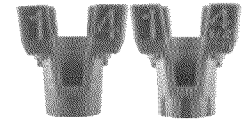
RECOmmENDATIONS	
gold and Silver mining	
Solution	gold & silver solutions
pH Range	3.0 to 9.0

Note: Can be used for copper mining with weak sulfuric acid solutions (less than 10 gpl H_2SO_4)

The Senninger Super Spray provides a full 360° spray pattern and is designed to handle flows up to 14.2 gpm (3225 L/hr). It is extremely useful for evaporation of excess water in gold and silver mining installations.

Features

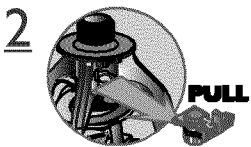
- No moving parts for longer life
- Built for strength and durability using high-impact engineering-grade thermoplastics
- Interchangeable deflector pads to customize spray angle and droplet size
- Inlet Sizes: 3/4" NPT male (1/2" NPT male model available with threaded nozzle)
- Flow range: 2.75 to 8.79 gpm (625 to 1996 L/hr) (consult factory for lower or higher flow rates.)
- One year warranty on materials and workmanship



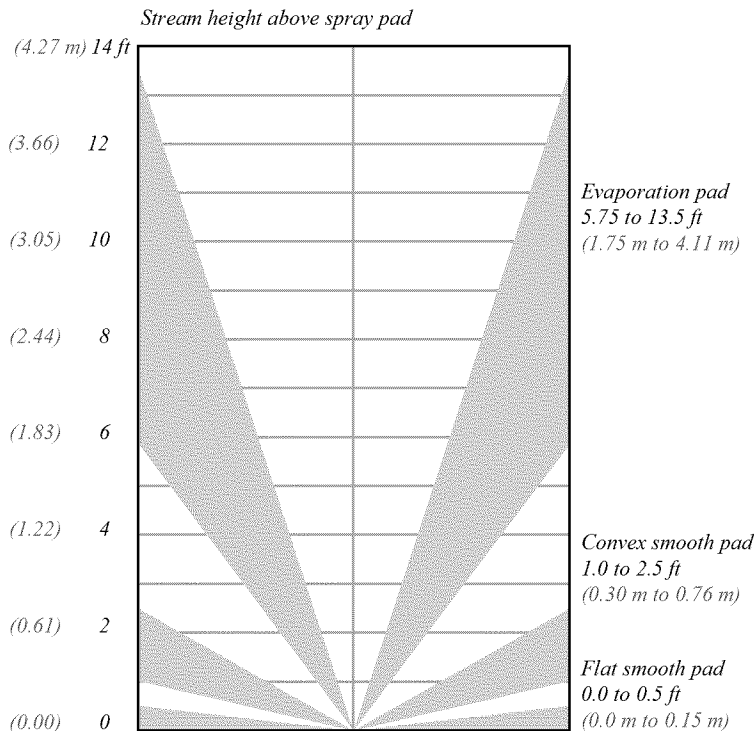
easy-Clean / nozzle Design

Just pinch and pull to remove the nozzle then place and click to re-install. cleaning and changing nozzles is easy and convenient. There is no need to disassemble or remove the sprinkler. The nozzle sizes are easily identifiable with color-coding and embossing on the ears, including half sizes (orifice diameters in 1/128 inch increments).

nozzle removal



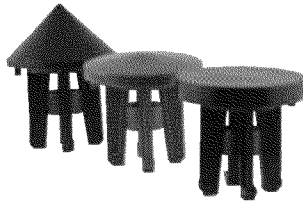
nozzle installation



Evaporation results will vary depending on wind, temperature, humidity and other factors. These variables must be considered when calculating evaporative performance.



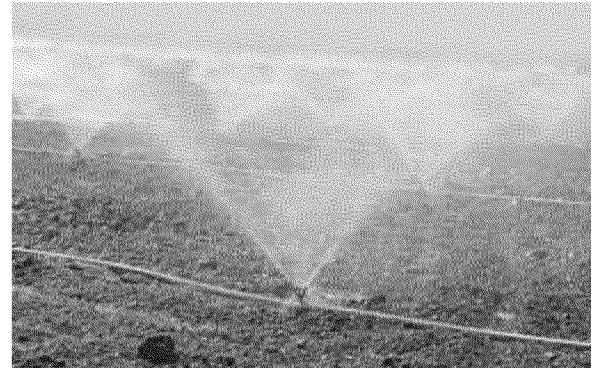
Sprays Super Spray



Consult factory for other deflector pad options.

Deflector Pads:

- evaporation (black)
- convex Smooth (green)
- Flat Smooth (black)



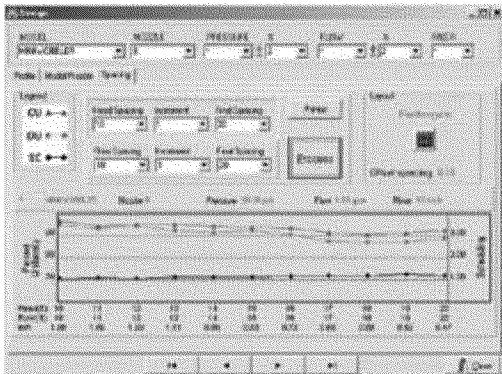
Super Spray

Sprinkler Base Pressure (psi)					(bar)				
	15	20	25	30		1.03	1.38	1.72	2.07
#10 Nozzle - Turquoise (5/32")					#10 Nozzle - Turquoise (3.97 mm)				
Flow (gpm)	2.75	3.17	3.55	3.88	Flow (L/hr)	625	720	806	881
evaporation Pad - diameter at 1.5 ft ht (ft)	22.0	24.0	25.0	25.0	evaporation Pad- diameter at 0.46 m ht (m)	6.7	7.3	7.6	7.6
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	24.5	28.5	31.5	31.5	convex-Smooth Pad - diameter at 0.46 m ht (m)	7.5	8.7	9.6	9.6
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	22.0	24.0	26.0	27.0	Flat-Smooth Pad - diameter at 0.46 m ht (m)	6.7	7.3	7.9	8.2
#11 Nozzle - Yellow (11/64")					#11 Nozzle - Yellow (4.37 mm)				
Flow (gpm)	3.33	3.84	4.30	4.71	Flow (L/hr)	756	872	977	1070
evaporation Pad - diameter at 1.5 ft ht (ft)	23.5	25.5	26.0	25.5	evaporation Pad- diameter at 0.46 m ht (m)	7.2	7.8	7.9	7.8
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	26.5	30.5	33.5	33.5	convex-Smooth Pad - diameter at 0.46 m ht (m)	8.1	9.3	10.2	10.2
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	22.5	24.5	26.5	27.5	Flat-Smooth Pad - diameter at 0.46 m ht (m)	6.9	7.5	8.1	8.4
#12 Nozzle - Red (3/16")					#12 Nozzle - Red (4.76 mm)				
Flow (gpm)	3.97	4.58	5.12	5.61	Flow (L/hr)	902	1040	1163	1274
evaporation Pad - diameter at 1.5 ft ht (ft)	25.0	27.0	27.0	26.0	evaporation Pad- diameter at 0.46 m ht (m)	7.6	8.2	8.2	7.9
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	28.0	32.0	35.0	35.0	convex-Smooth Pad - diameter at 0.46 m ht (m)	8.5	9.8	10.7	10.7
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	23.0	25.0	27.0	28.0	Flat-Smooth Pad - diameter at 0.46 m ht (m)	7.0	7.6	8.2	8.5
#13 Nozzle - White (13/64")					#13 Nozzle - White (5.16 mm)				
Flow (gpm)	4.66	5.38	6.02	6.59	Flow (L/hr)	1058	1222	1367	1497
evaporation Pad - diameter at 1.5 ft ht (ft)	26.5	28.5	28.0	26.5	evaporation Pad- diameter at 0.46 m ht (m)	8.1	8.7	8.5	8.1
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	29.5	33.5	36.0	36.0	convex-Smooth Pad - diameter at 0.46 m ht (m)	9.0	10.2	11.0	11.0
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	23.5	25.5	27.5	28.5	Flat-Smooth Pad - diameter at 0.46 m ht (m)	7.2	7.8	8.3	8.7
#14 Nozzle - Blue (7/32")					#14 Nozzle - Blue (5.56 mm)				
Flow (gpm)	5.41	6.25	6.99	7.65	Flow (L/hr)	1229	1420	1588	1738
evaporation Pad - diameter at 1.5 ft ht (ft)	28.0	29.5	28.5	27.0	evaporation Pad- diameter at 0.46 m ht (m)	8.5	9.0	8.7	8.2
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	31.0	35.0	37.0	37.0	convex-Smooth Pad - diameter at 0.46 m ht (m)	9.5	10.7	11.3	11.3
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	23.5	26.0	28.0	29.0	Flat-Smooth Pad - diameter at 0.46 m ht (m)	7.2	7.9	8.5	8.8
#15 Nozzle - Dark Brown (15/64")					#15 Nozzle - Dark Brown (5.95 mm)				
Flow (gpm)	6.22	7.18	8.03	8.79	Flow (gpm)	1413	1631	1824	1996
evaporation Pad - diameter at 1.5 ft ht (ft)	29.0	30.0	29.0	27.5	evaporation Pad- diameter at 0.46 m ht (m)	8.8	9.2	8.8	8.4
convex-Smooth Pad - diameter at 1.5 ft ht (ft)	32.0	36.0	38.0	38.0	convex-Smooth Pad - diameter at 0.46 m ht (m)	9.8	11.0	11.6	11.6
Flat-Smooth Pad - diameter at 1.5 ft ht (ft)	24.0	26.5	28.5	29.5	Flat-Smooth Pad - diameter at 0.46 m ht (m)	7.3	8.1	8.7	9.0

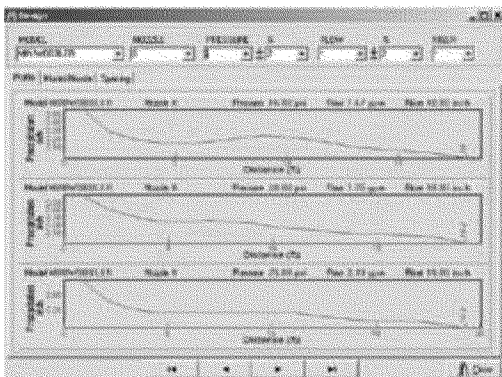
Sprinkler performance may vary with actual field conditions. Other nozzle sizes are available. Consult factory for specific performance data. See page 13 for stream height diagram.

mining WinSiPP2 Software

INTROduced IN 1993



Profiles illustrate the coefficient of uniformity, distribution uniformity, and the scheduling coefficient to determine which spacing would be optimum.



Sprinkler profiles can illustrate how much water a sprinkler can deliver at various intervals and its radius of throw.

Use Mining WinSiPP2 software by Senninger to calculate the precipitation rate of your leach pad.

Features

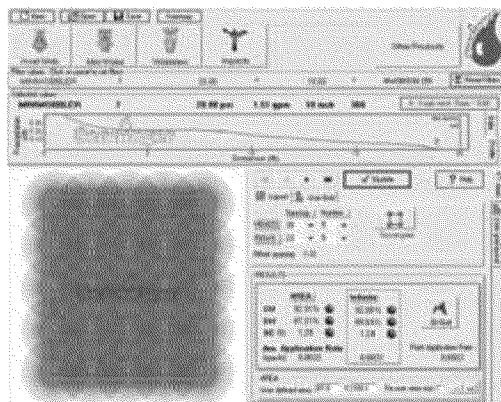
- Tests the application uniformity of sprinkler layouts before the system is installed
- compares different spacings, sprinkler models, nozzle sizes, and operating pressures to determine which would be best for your specific application
- Sprinkler profile uses specific data and illustrates the amount of water that would be delivered at various intervals, the application radius, and the water distribution of multiple overlapping devices.

Distribution Profiles

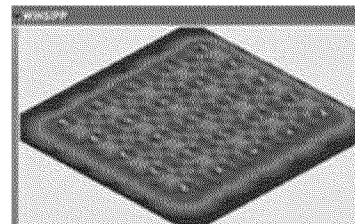
a distribution profile is the illustration of results from "catch can" tests performed in accordance with the American Society of Agricultural and Biological Engineers (ASABE) standard S398.1. This data shows how uniformly a device distributes water within its diameter of throw. WinSiPP2 utilizes the numerous distribution profiles available for Senninger products.

Densograms

data from distribution profiles is used to create densograms based on spacing dimensions, layout, and riser height.



densograms illustrate the uniformity, wetted diameter, and application pattern of a given profile.



graphics illustrate the water application pattern in a 3d format.

Ask for this program by contacting the Senninger Technical Support Department



Other applications

Irri-Maker operates within the larger Model Maker™ environment. This means any of the other Model Maker modules can be added to your software packages such, civil earthwork calculation tasks can be performed for various applications including canals, drainage and roads.

Call for information about purchasing this program and your FREE sample CD.

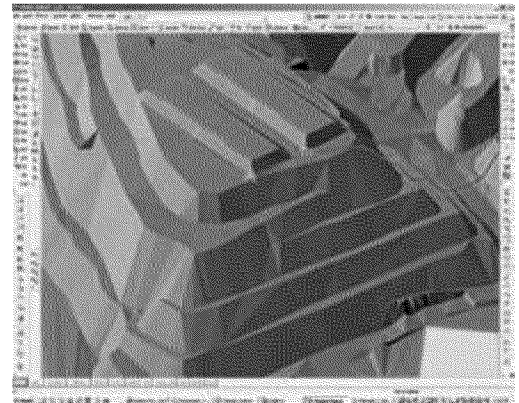
Senninger's Irri-Maker software evaluates installation alternatives in advance, surveys any terrain, produces a contour plan, draws the details, and applies the irrigation design.

Features

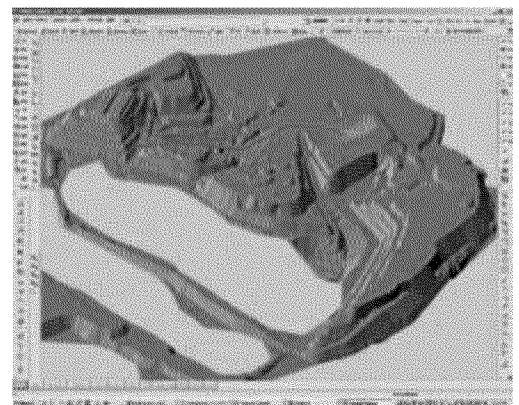
- Optimizes irrigation system design by combining survey, digital Terrain Modeling (dTM), and computer-aided design (cad) with many hydraulic analysis functions
- evaluates installation alternatives in advance – surveys any terrain, produces a contour plan, draws the details, and applies the irrigation design
- allows importation of information from many other programs
- Saves time at repeatable routines

survey data Manipulation (dTM)

Irri-Maker's flexible structure and user-friendly layout makes converting survey data into a computerized dTM format quick and easy. It is no longer necessary to manually calculate coordinates, reduce survey field books, or do manual plotting of the proposed terrain. Irri-Maker can produce a contour plan from virtually any type of survey data.



3D design of leaching pad.



Terrain modeling of excavation area.

cad advantages

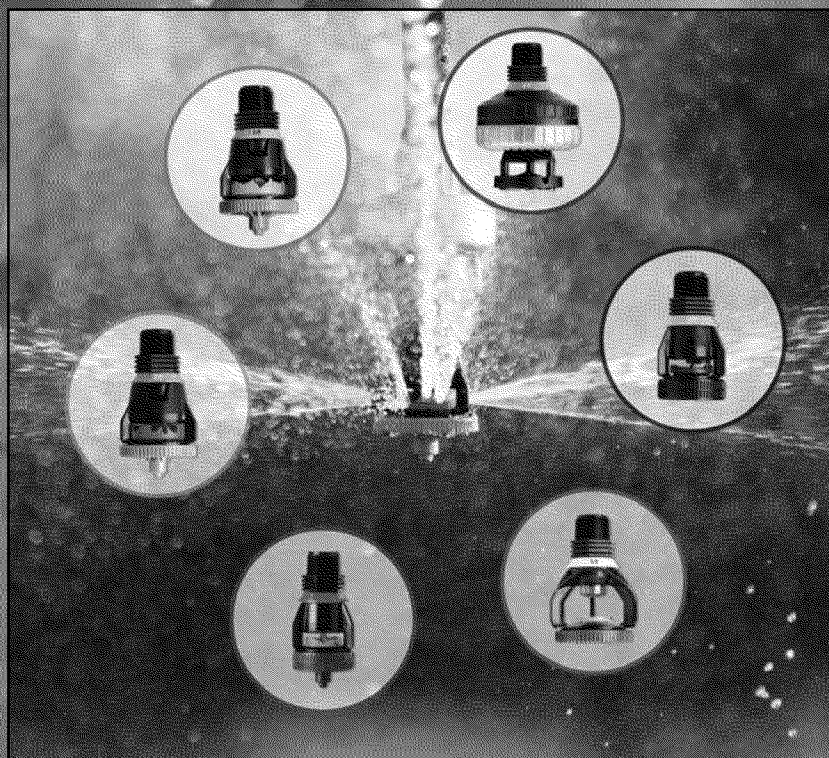
The built-in cad module allows you to add specific details like roads, fences, boundaries and rivers to the contour plan, including text and bitmap images. Irri-Maker has various modules working together with the same set of commands. There is no need to learn different programs or menu layouts to add cad elements and irrigation designs to your contour plan. everything can be plotted independently or in combination.

Flexible irrigation designs

Irri-Maker can be used for everything from simple irrigation designs to complex systems. each element of the design can be controlled, whether it's defining block areas, adding emitters and pipes, sizing the pipes, or calculating the hydraulic. a comprehensive list of materials along with detailed hydraulic reports can be produced as well.

Appendix B.2 Nelson Irrigation Specifications

water application solutions FOR CENTERPIVOT IRRIGATION



Nelson 3000 Series Pivot Products

R	S	O	D	A	T
R3000	S3000	O3000	D3000	A3000	T3000

NELSON

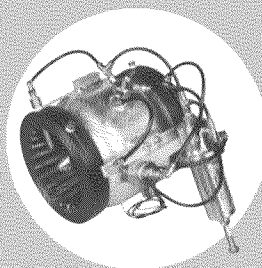
save water, save energy and do a better job of irrigating.

FROM PIVOT POINT TO END GUN

Nelson Irrigation Corporation offers a full-range of water application solutions for center pivot irrigation. From control valves, to pivot sprinklers and pressure regulators to end guns—the package is complete. Efficiency and effectiveness are at the heart of this superior center pivot irrigation package. **Save water, save energy and do a better job of irrigating with Nelson products.**

PRESSURE REGULATORS

Nelson Pressure Regulators are precision manufactured and feature a patented dampening system, improved plug resistance with a patented single strut design, and extended flow range.

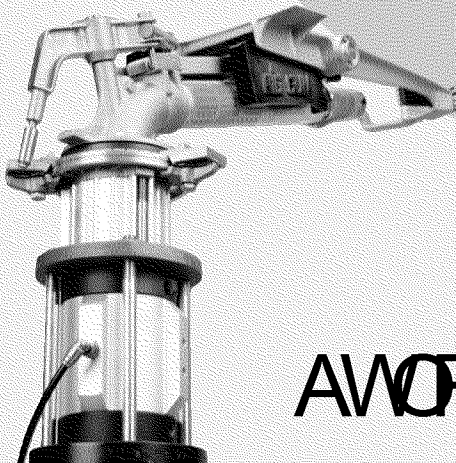


CONTROL VALVES

You'll fully appreciate the extra built-in quality and reliability of a Nelson control valve when it performs under the most demanding operating conditions. Specify a Nelson 800 Series Control Valve at the Pivot Point and as part of your End Gun Control Package.

3000 SERIES PIVOT SINKERS

Only Nelson offers such a complete line of advanced design pivot sprinklers. A highly-intuitive modular system of components make up Nelson's 3000 Series Pivot Products.



BIG GUN® SINKERS

All end guns are not the same. Only the Nelson SR series Big Guns® have stood the test of time on center pivots—recognized the world over as the leader in quality and performance.

A WORLDWIDE REPUTATION FOR EXCELLENCE

UNIFORMITY BEGINS WITH THE ASSURANCE OF QUALITY. Nelson Irrigation has the highest standards in engineering design, precision manufacturing, and quality assurance with state-of-the-art sprinkler package design software.

FOCUS ON SOLUTIONS. Nelson Irrigation offers a complete line of pivot sprinklers that provide the perfect combination of features to irrigate a multitude of crops — corn, cotton, potatoes, alfalfa — to name a few.

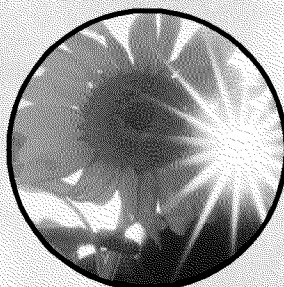
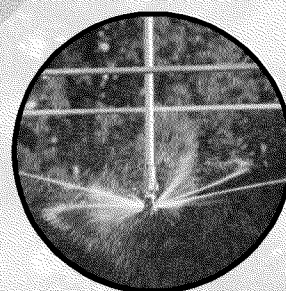
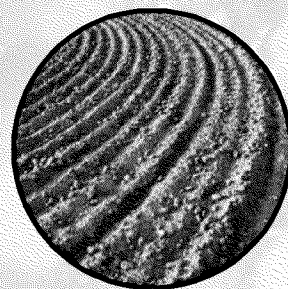
CHOOSE HIGH PERFORMANCE. Nelson's 3000 Series Pivot Products take into account the variety of soils and their differing content of sand, silt, and clay. Water droplet size and energy affect both wind-fighting ability and the integrity of the soil structure. Choose the product that best fits your soil type and maximizes efficiency.

INCREASE PRODUCTIVITY. Center pivot irrigation has proven itself to be a highly effective and efficient means of irrigation. Take advantage of the benefits of improved uniformity and high application efficiency. Solve problems like runoff, while increasing yield and grade.

MAXIMIZE IRRIGATION EFFICIENCY. The need to save water, save energy, and do a better job of irrigating is no longer an option — it's a necessity. Nelson Irrigation is focused and very dedicated to doing things that improve the state-of-the-art of agricultural irrigation by making products that maximize efficiency and uniformity at lower pressure.

IT'S SIMPLE

Choose the right sprinkler configuration for your crop type, soil type, system type, and water and energy needs.



SPECIFY NELSON ON BOARD



PRODUCTS THAT MEET YOUR NEEDS

> an irrigation SYSTEM—it's greater than the sum of its parts

S 3000 spinner

GENTLE RAIN AT LOW PRESSURE. The free-spinning action of the S3000 Spinner provides a gentle, rain-like droplet for sensitive soils and crops.

SUPERIOR UNIFORMITY AT LOW PRESSURE. A low pressure alternative to fixed sprayheads, the S3000 provides higher uniformity with better overlap and lower application rates.



R 3000 rotator®

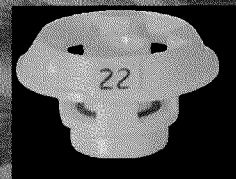
GREATER THROW RADIUS. As a rotating type sprinkler the R3000 Rotator® produces a wider pattern resulting in a lower application rate, reduced runoff and longer soak time.

HIGHER UNIFORMITY. The R3000 greatly improves uniformity because of the increased overlap from adjacent sprinklers.

REDUCED WIND DRIFT AND EVAPORATIVE LOSS. The R3000 more than meets the challenge of putting a rotating type sprinkler on drop tubes—down out of the wind—to minimize wind drift and evaporative loss.



> 3TN

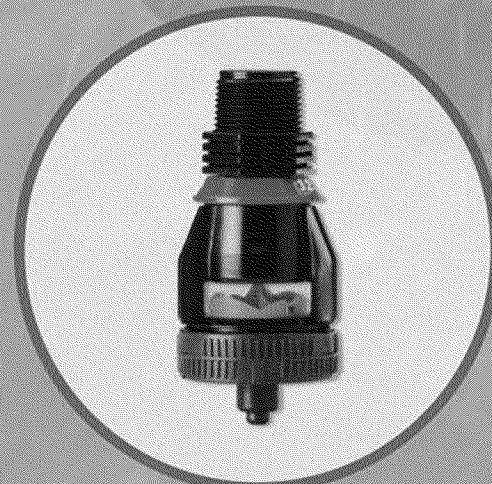








THE 3TN NOZZLE
IS THE CENTER
OF THE 3000
SERIES SPOT
PRODUCT LINE

A 3000 accelerator

DESIGNED FOR IN-CANOPY WATER APPLICATION. A hybrid sprinkler using both Rotator® and Spinner technology, the Accelerator increases rotation speed as the nozzle size increases. This maximizes throw distance and minimizes evaporative losses at low flow rates. At the end of the system it transforms into a Spinner to lower instantaneous application rates while treating the soil correctly.

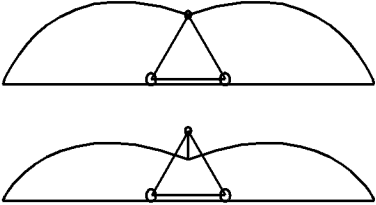
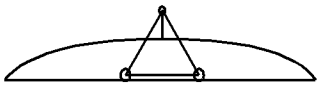
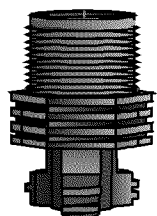
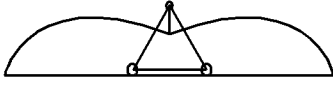

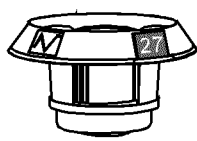
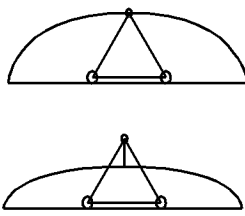
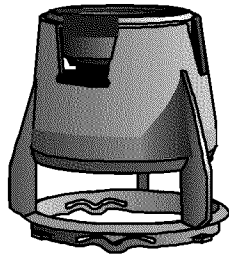
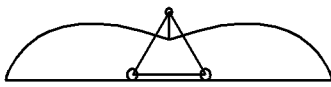

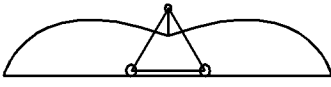
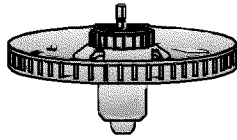
MAXIMUM APPLICATION EFFICIENCY. Operating at 10 psi (0.7 BAR) the A3000 maintains the lowest possible trajectory angle without sacrificing throw distance.



> 3000 series		DESCRIPTION	NOZZLE TYPE	OPERATING RANGE	APPLICATION RATE
R	R3000	 rotator® <p>The R3000 Rotator® features the greatest throw distance available on drop tubes. The wide water pattern from rotating streams equates to lower average application rates, longer soak time and reduced runoff. More overlap from adjacent sprinklers improves uniformity.</p>	3TN	15-50 PSI (1-3.4 BAR)	LOW
S	S3000	 spinner <p>The S3000 Spinner utilizes a free-spinning action to produce a gentle, rain-like water pattern. Designed for more sensitive crops and soils, low instantaneous application rates and reduced droplet kinetic energy help maintain proper soil structure.</p>	3TN	10-20 PSI (0.7-1.4 BAR)	LOW - MEDIUM
O	O3000	 orbitor <p>The O3000 Orbitor is designed with an innovative bracketless assembly. Debris hang-up and water-pattern misting common to conventional sprinklers are eliminated.</p>	3TN	10-20 PSI (0.7-1.4 BAR)	LOW - MEDIUM
D	D3000	 sprayhead <p>The D3000 Sprayhead is a fixed spray designed with future needs in mind. As irrigation requirements change throughout the season, the D3000 features a flip-overcap to change spray patterns. The D3000 is easily convertible to LEPA or other 3000 Series sprinklers.</p>	3TN	6-40 PSI (.41-2.8 BAR)	HIGH
A	A3000	 accelerator <p>The A3000 Accelerator maximizes performance of in-canopy water application. Designed as a hybrid of Rotator and Spinner technology, the Accelerator increases rotation speed through the nozzle range.</p>	3TN	10-15 PSI (0.7-1 BAR)	MEDIUM
T	T3000	 trashbuster <p>Developed for the land application of wastewater, the T3000 Trashbuster features an open-architecture body design to pass debris more easily. Available with the 3000 FC, a plug-resistant, flow compensating sprinkler package can simplify maintenance.</p>	3TN or 3000 FC	Depends on sprinkler selection	LOW - HIGH

*Careful selection of pressure and sprinkler configuration must be taken into account to optimize droplet size.

**Throw Distance Varies with Pressure, Nozzle Size, Mounting Height and Hydraulic Conditions.

MOUNTING	RELATIVE THROW DIAMETER**	FEATURES & BENEFITS
Up Top or On Drops	50-74' (15.2-22.6 m) 	MODULARITY = ECONOMY & EFFICIENCY Nelson 3000 Series Pivot Products are easy to change/inter-change to give you the best configuration for your ever-changing conditions.
On Drops	42-54' (12.8-16.5 m) 	 <p>A square thread fitting or a square thread Universal Regulator are a great way to connect sprinkler & hose</p>
On Drops (flex hose) <p>IMPORTANT! The Orbitor requires a minimum of 2' (0.6 m) of reinforced flexible hose in the mounting assembly. It also requires the 0.85lb. integral weight in all installations. Do not use any other conventional weight styles instead of, or in addition to, the Orbitor weight.</p>	47-58' (14.3-17.7 m) 	3TN NOZZLES <ul style="list-style-type: none"> ▪ Quick-Change ▪ Color-Coded ▪ Easily Identifiable   <p>(Odd-numbered nozzles have a color marking the color of the next size nozzle.)</p>
Up Top or On Drops	16-40' (4.9-12.2 m) 	 <p>All 3000 Series Pivot Products Bodies have a "CROP-GUARDED" design to prevent hang-ups when the sprinkler is down in the crop.</p>
On Drops	30-46' (9.1-14.0 m) 	 <p>The 3000 Series high-performance plates are engineered to provide the optimal droplet size for various conditions.</p>
Up Top or On Drops <p>IMPORTANT! Do not use 3000FC with hose drops.</p>	Depends on Sprinkler Selection 	

3000 Series Pivot Products

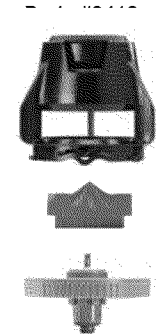
The 3TN “One” Nozzle system is a complete assembly of a cap, plate, and body. The 3TN Nozzle is interchangeable with all 3000 Series pivot sprinklers. A variety of connecting components are available to link the sprinkler with the mainline.









3/4" FNPT x Square Thread		
	Uni-Flo	Hi-Flo
6 PSI	9572-001	9611-001
10 PSI	9572-002	9611-002
15 PSI	9572-003	9611-003
20 PSI	9572-004	9611-005
25 PSI	9572-005	9611-006
30 PSI	9572-006	9611-007
40 PSI	9572-007	9611-008
50 PSI	9572-008	9611-009

3/4" FNPT x 3/4" FNPT		
	Uni-Flo	Hi-Flo
6 PSI	9491-001	9071-001
10 PSI	9491-002	9071-002
15 PSI	9491-003	9071-003
20 PSI	9491-004	9071-005
25 PSI	9491-005	9071-006
30 PSI	9491-006	9071-007
40 PSI	9491-007	9071-008
50 PSI	9491-008	9071-009

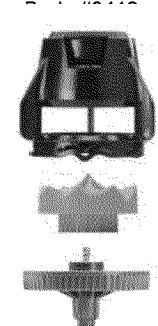
R3000








R3000 Cap #9539

Blue Up-Top U4-8°	White Up-Top	Green D4-8°	Red D6-12°	Orange Multi-Trajectory	Brown Multi-Trajectory
					
Plate #8817 Cap/Plate Assy* #11969-001 Cap/Plate Body Assy* #11970-001	Plate #10749 Cap/Plate Assy* #11969-002 Cap/Plate Body Assy* #11970-002	Plate #8844 Cap/Plate Assy* #11969-003 Cap/Plate Body Assy* #11970-003	Plate #8839 Cap/Plate Assy* #11969-004 Cap/Plate Body Assy* #11970-004	Plate #10598 Cap/Plate Assy* #11969-005 Cap/Plate Body Assy* #11970-005	Plate #10681 Cap/Plate Assy* #11969-006 Cap/Plate Body Assy* #11970-006
20-50 PSI (1.4-3.4 bar)	15-30 PSI (1.0-2.0 bar)	20-50 PSI (1.4-3.4 bar)	15-30 PSI (1.0-2.0 bar)	15-30 PSI (1.0-2.0 bar)	15-30 PSI (1.0-2.0 bar)

S3000



S3000 Cap #9540

Red D6-12°	Purple D6-20°	Yellow D8-21°	Beige Small Nozzle	Part Circle Spinner
				
Plate #8839 Cap/Plate Assy* #11971-001 Cap/Plate Body Assy* #11972-001	Plate #9583 Cap/Plate Assy* #11971-002 Cap/Plate Body Assy* #11972-002	Plate #10361 Cap/Plate Assy* #11971-003 Cap/Plate Body Assy* #11972-003	Plate #11013	Part Circle Spinner #9926-001
10-20 PSI (0.7-1.4 bar)	10-20 PSI (0.7-1.4 bar)	10-20 PSI (.7-1.4 bar)	10-15 PSI (0.7-1.0 bar) Operates with a #10-15 nozzle. Ultra-low flow.	

*Part numbers do not include the 3/4" Adapter & 3TN Nozzle that are required for a complete Assembly.

> UNIVERSAL FLO 3000 series PRESSURE REGULATORS

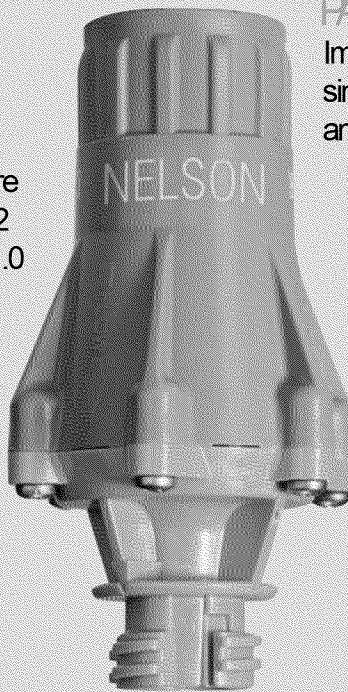
The function of a pressure regulator in center pivot sprinkler design is to fix a varying inlet pressure to a set outlet pressure, regardless of changes in the system pressure due to hydraulic conditions, elevation changes, pumping scenarios, etc. The benefits include a uniform depth of water application, controlled sprinkler performance (droplet size and throw distance), and flexibility in system operation. Specify Nelson's Universal Flo 3000 Series Regulator in your sprinkler package.

WIDE FLOW RANGE

The Nelson Universal Pressure Regulator has a flow up to 12 GPM (2.7 M³/H) at 15 PSI (1.0 BAR) and above.

PATENTED DAMPENING SYSTEM

A patented o-ring dampening system handles severe pressure surges to withstand water hammer.



PATENTED PLUG RESISTANT DESIGN

Improved plug-resistance with a new single-strut seat design in both the Hi-Flo and Universal Flo models.

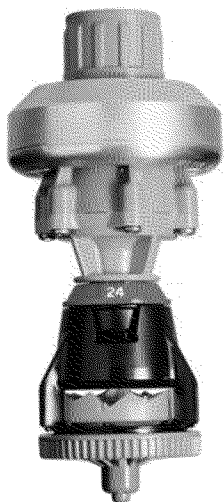
EXTENDED PERFORMANCE & PRECISION ACCURACY

Precision components coupled with an internally lubricated o-ring minimize frictional drag and hysteresis.

CHEMICALLY RESISTANT MATERIALS

UNIVERSAL 3000 SERIES CONNECTION

Integral adapter connects directly into all Nelson 3000 Series Sprinklers.



1 LB. WEIGHT FOR FLEXIBLE HOSE DROPS

The modular weight fits onto all Nelson Pressure Regulators. When pressure regulators are not used, the weight fits securely on the body of 3000 Series sprinklers (not to be fitted directly on the N3000 Nutator). The 1 lb. Modular Pivot Weight is designed for Nelson 3000 Series products operating at 20 PSI (1.4 BAR) and below.

TECHNICAL TIPS FOR REGULATING SYSTEMS

IMPORTANT: Allow approximately 5 PSI (.35 BAR) extra pressure in order for the regulator to function properly. For example, the minimum design pressure for a 20 PSI (1.4 BAR) pressure regulator is 25 PSI (1.7 BAR).

IMPORTANT: If your system is designed with Nelson sprinklers, use Nelson Pressure Regulators. Individual manufacturers' pressure regulator performance varies. Interchanging could result in inaccurate nozzle selection.

Nelson Irrigation Corporation

<http://www.nelsonirrigation.com>

848 Airport Rd. Walla Walla

WA 99362-2271 U.S.A.

Tel:(509) 525-7660 Fax: (509) 525-7907

E-mail: info@nelsonirrigation.com

R3000 FEATURES

GREATER THROW RADIUS. The R3000 Rotator® features the greatest throw distance available on drop tubes. As a rotating type sprinkler the R3000 produces a wider pattern resulting in a lower application rate, reduced runoff and longer soak time.

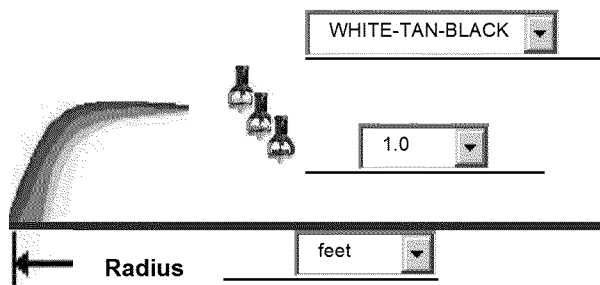
HIGHER UNIFORMITY. The R3000 greatly improves uniformity because of the increased overlap from adjacent sprinklers.

REDUCED WIND DRIFT AND EVAPORATIVE LOSS. The R3000 more than meets the challenge of putting a rotating type sprinkler on drop tubes 'down out of the wind' to minimize wind drift and evaporative loss.

COLOR-CODED NOZZLES. The 3TN Nozzle system is at the center of the 3000 Series Pivot Product line with easy-to-identify, wear-resistant, precision-accurate nozzles. The quick-change adapter allows you to remove the Rotator for easy cleaning of a plugged nozzle without tools and without shutting down the system. It's a snap to change nozzles in mid-season.

VERSATILE MODULAR DESIGN. Because no one sprinkler is right for all conditions, the 3000 Series features modular design components which are easily changed with a simple push and turn. You may want to start out the season with one configuration and change to a different one later.

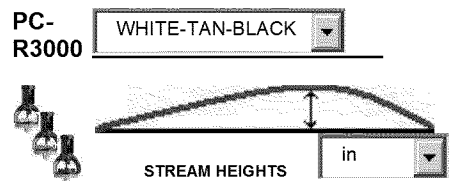
ADVANCED DESIGN. The plates of the R3000 Rotator are specifically engineered for high performance: Speed Control, Uniformity built-in, Droplet control solutions - Gentle for sensitive crops and soils, Windfighting for maximum irrigation efficiency



Stated performance at nozzle pressure. Tested at 1250 feet above sea level. Sprinkler performance data have been obtained under ideal test conditions and may be adversely affected by wind, poor hydraulic entrance conditions, or other factors. Nelson Irrigation Corporation makes no representation regarding droplet conditions, uniformity, or application rate.

Mount on rigid drop or IACO Hose Boom Assembly

	Nozzle Size							
psi	14	20	24	30	36	40	44	50
15	17	20	21	19	19	23	24	24
20	19	21	22	21	21	26	27	27
25	21	22	23	22	22	28	28	29
30						30	30	30

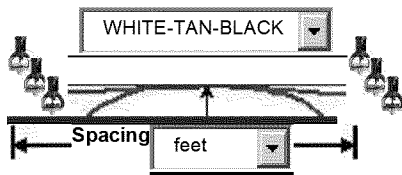


Height values shown indicate the maximum height of major droplets emitted from a level sprinkler under no wind conditions. Sprinklers should be mounted at least this far below the pivot structure to minimize wetting of the system, but they may be mounted slightly higher without significantly affecting the sprinkler pattern. Nelson Irrigation Corporation makes no representation regarding droplet conditions, uniformity, or application rate.

Mount on rigid drop or IACO Hose Boom Assembly

	Nozzle Size							
psi	14	23	24	30	39	40	44	50
15	20	30	10	13	14	29	29	26
20	23	37	13	16	17	35	35	30
25	27	39	17	17	18	39	39	33
30						41	41	35

PC-R3000 PARAMETERS



Note: Some of these limits have been expanded for simplification in this version of NelsonPRODUCTS. They may allow application of the product at slightly higher or lower pressures than current sprinkler package calculation programs.

Mount on rigid drop or IACO Hose Boom Assembly

Nozzle		Pressure (psi)	Spacing
Size	Plate		
#14 - #15	WHITE	15.0 - 26.0	11.0
#16 - #23	WHITE	14.0 - 26.0	11.0
#24 - #39	TAN	14.0 - 24.0	11.0
#40 - #50	BLACK	13.0 - 30.0	11.0

PC-R3000.xml October 9, 2015

Appendix C Specmeter Soil Moisture Specifications

WATERSCOUT[®] SM 100 Soil Moisture Sensor

OVERVIEW

Keeping track of your field's soil moisture status allows you to better schedule irrigations and evaluate the effectiveness of rain and irrigation water. Regular monitoring will give you an accurate picture of this process over time.

The SM100 combines affordability and accuracy into a sensor that is easy to install. The sensor is composed of two electrodes that function as a capacitor with the surrounding soil serving as the dielectric. An 80 MHz oscillator drives the capacitor and a signal proportional to the soil's dielectric permittivity is converted to an output signal that is then converted to volumetric water content.

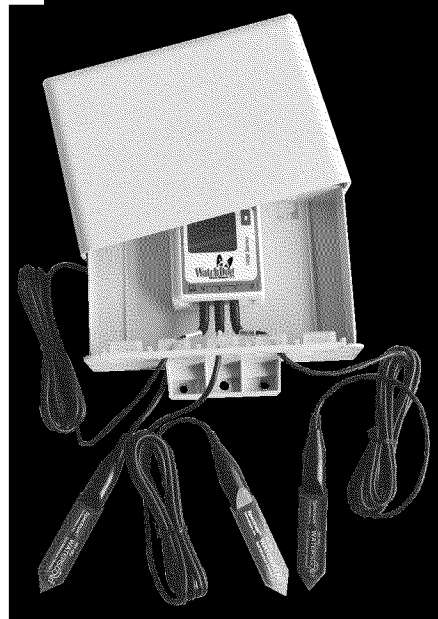
The SM100 is designed to be compatible with WatchDog[®] data loggers and stations. SpecWare software enables you view your data in graphical and tabular form as well as run reports customized to your application.

STANDARD INTERFACES

- WatchDog 2000 Series Weather Stations (Models 2900ET, 2800, 2700, 2600)
- WatchDog 2000 Series Mini Stations (Models 2475, 2450, 2425, 2400)
- WatchDog 1000 Series Micro Stations (Models 1650, 1525, 1450, 1425, 1250, 1225, 1200)
- FieldScout Soil Sensor Reader
- Older versions of the WatchDog 2000 Series Weather Stations with serial numbers earlier than 2310 can accommodate only two SM 100 sensors



FieldScout Soil Sensor Reader connected to a buried WaterScout SM 100 Soil Moisture Sensor.



WatchDog 1000 Series Soil Moisture Micro Station shown with three WaterScout SM 100 Soil Moisture Sensors.

Spectrum[®]
Technologies, Inc.

"To Measure Is To Know"

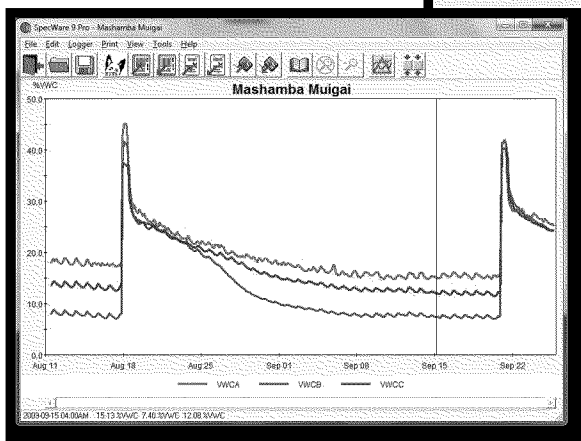
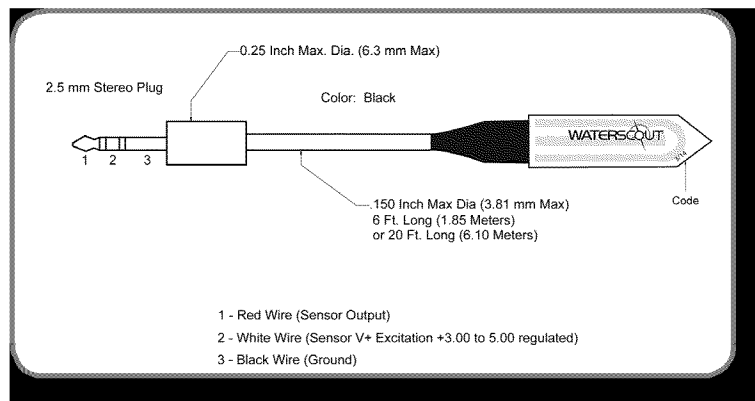
3600 Thayer Court
Aurora, Illinois 60504

Toll Free: (800) 248-8873 • Phone: (815) 436-4440

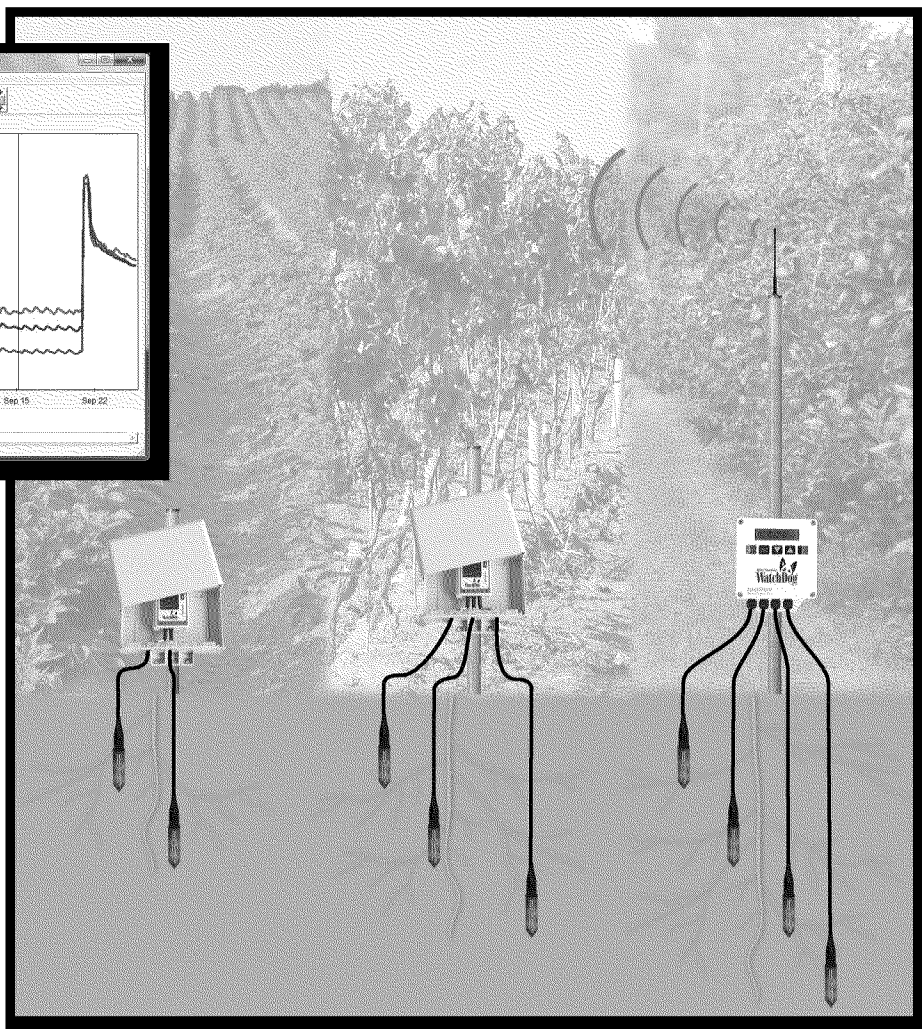
Fax: (815) 436-4460 • E-mail: info@specmeters.com

SPECIFICATIONS

- Cable length: 6 and 20ft. extendable up to 100ft.
- Dimensions: 2.4in (6cm) x 0.8in (2cm) x 0.1in (0.3cm)
- Accuracy: 3% VWC @ EC < 8 mS/cm
- Resolution: 0.1% VWC
- Oscillator frequency: 80 MHz
- Output: Analog voltage proportional to excitation voltage (0.5 to 1.5 V for a 3V excitation)
- Power: 3 to 5V @ 6 to 10mA
- Range: 0% VWC to saturation
- Connector: 2.5mm stereo pin
- Temperature: 33 - 175°F (0.5 - 80°C)
- Calibration: Sensors with 3/14 code can be re-calibrated using the FieldScout Soil Sensor Reader (item 6466)



You can collect data and log results when the WaterScout SM 100 Soil Moisture Sensor is connected to a WatchDog Station.



WatchDog 1000 Series Micro Station (left and center) and WatchDog 2000 Series Mini Station (right) shown with multiple WaterScout SM 100 Soil Moisture Sensors. The Mini Station may also be connected with wireless communications options, allowing for remote data collection.

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Aurora, Illinois 60504

Toll Free: (800) 248-8873 • Phone: (815) 436-4440

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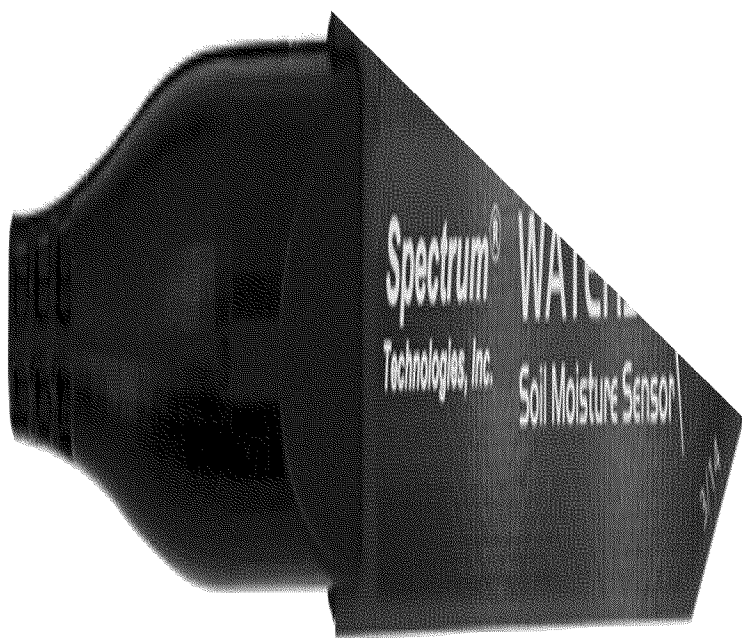
R-3/14



SM100 Soil Moisture Sensor

PRODUCT MANUAL

Item # 6460



CONTENTS

General Overview	3
Specifications	4
Sensor Wiring Diagram	4
Sensor Placement	5
Hardware/Software Compatibility	6
Checking the Sensor	7
Sensor Calibration	8
Installation	9
Soil-Specific Calibration	12
Volumetric Water Content	18

This manual will familiarize you with the features and operation of your new WaterScout SM100 Soil Moisture Sensor. Please read this manual thoroughly before using your instrument. For customer support, or to place an order, call Spectrum Technologies, Inc. at (800)248-8873 or (815) 436-4440 between 7:30 am and 5:30 p.m. CST, FAX at (815)436-4460, or E-Mail at info@specmeters.com. www.specmeters.com

Spectrum Technologies, Inc.

General Overview

Thank you for purchasing a WaterScout SM100 Soil Moisture Sensor.

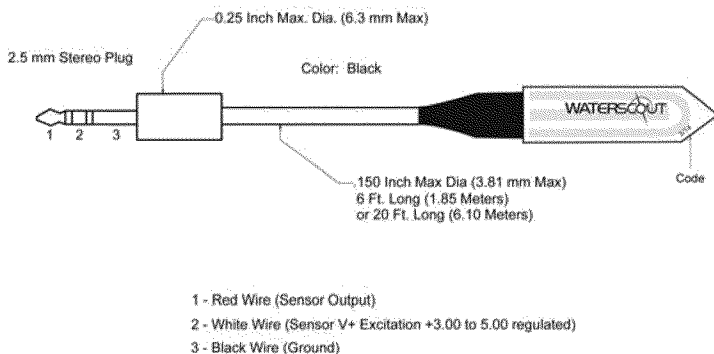
The sensor is made up of two electrodes that function as a capacitor, with the surrounding soil serving as the dielectric. An 80 MHz oscillator drives the capacitor and a signal proportional to the soil's dielectric permittivity is converted to the output signal. The dielectric permittivity of water is much greater than air, soil minerals and organic matter. So, changes in water content can be detected by the sensor circuitry and correlated to the soil's moisture content.

The SM100, in conjunction with a Soil Sensor Reader or a WatchDog weather station, will give you a better idea of how fast soil water is being depleted in different areas of your field. By keeping track of your field's soil moisture status between irrigations, you can better schedule irrigations and evaluate the effectiveness of rain and irrigation water. Regular monitoring will give you an accurate picture of this process over time. Download the accumulated data at your convenience. SpecWare will present data in graphical and tabular form. Use the software to view daily, monthly and yearly reports.

Specifications

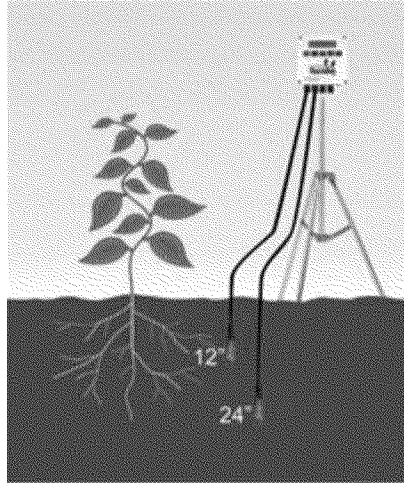
Standard Interfaces	WatchDog weather stations, mini stations, and micro stations FieldScout Soil Sensor Reader
Connector	2.5mm stereo pin
Range	0% VWC to saturation
Power	3 to 5V @ 6 to 10mA
Output	Analog voltage proportional to excitation voltage (0.5 to 1.5 V for a 3V excitation)
Oscillator Frequency	80 MHz
Resolution	0.1% VWC
Accuracy	3% VWC @ EC < 8 mS/cm
Sensor Dimensions	2.4in. (6cm) x 0.8in (2cm) x 0.1in (0.3cm)
Cable length	6 and 20ft. extendable up to 50ft.
Temperature Range	33 to 175°F (0.5 to 80°C)

Sensor Wiring Diagram



Sensor Placement

The sensors should be located in the effective root zone and at locations that will give a representative picture of the soil water status of the field. Areas of the field planted to different crops or with significant differences in factors such as topography or soil type should be considered unique soil moisture environments. Selecting a site which receives the least amount of water from the irrigation system will tell you when that area becomes critically dry and is in need of attention. Typically, one or two sensors should be installed in the root zone. A single sensor should be placed in the middle of the root zone. When two sensors are installed at a single site, it is recommended to place one sensor at the top of the root zone and a second at the bottom. An advantage of installing multiple sensors is it allows you to see how well irrigation and rainwater is moving through the soil profile.



The SM100 is most sensitive to the soil adjacent to the sensor. Therefore, good contact between the soil and sensor is important. Stones and air pockets next to the sensor will affect the accuracy of the readings. Because it is sensitive to differences in dielectric permittivity, care should be taken not to install the sensor in or near metal.

Hardware / Software Compatibility

There are some restrictions on which equipment is compatible with the WaterScout and how many sensors can be connected to a single unit. These are outlined below.

Soil moisture sensor reader

Non data-logger. Reads one sensor at a time. Requires firmware version 3 or greater.

2000-series mini stations (2400, 2425, 2450, 2475)

Require firmware version 1.9 or greater and SpecWare version 9.0 Build 202 or greater. Models with serial number 2310 or greater were manufactured to accommodate the SM100 on all available channels. Compatible stations will have a “W” in the manufacturing code that accompanies the serial number. Stations with earlier serial numbers can accommodate only one SM100.

2000-series weather stations (models 2550, 2700, 2900)

Require firmware version 6.1 or greater and SpecWare version 9.0 Build 202 or greater. Models with serial number 2310 or greater were manufactured to accommodate the SM100 on all available channels. Compatible meters will have a “W” in the manufacturing code that accompanies the serial number.

(model 2800)

Similar to other weather stations, but requires firmware version 2.4.

1000-series micro stations (models 1200 to 1600)

All firmware versions are compatible with the SM100. Require SpecWare version 9.02 or greater. Any available sensor port can be connected to an SM100 sensor.

Early 2000-series weather stations

2000-series weather stations with serial numbers earlier than 2310 can accommodate only two SM100's. The limitation is that only one sensor can be on ports C through F. The other sensor can be on ports A or B (or G or H in the case of a model 2800 station). Earlier versions of the 2000-series mini stations can accommodate one SM100 sensor. The firmware and software requirements for SM100-compatible stations still apply.

Original WatchDog weather stations (models 525, 550, 600, 700, and 900), 200- and 400- series purple loggers, and A-series loggers are incompatible.

Checking the Sensor

Calibration equations for the SM100 were developed using mineral soils and a soilless material (peat moss). Therefore the sensor will not give a value of 100% in water. To check if the sensor electronics are still functioning properly, they may be checked in the following media:

Air

In air, the sensor should read a VWC of 0%.

Water

In distilled water, the sensor should read a VWC of about 55% in Standard mode and about 68% in Soilless mode.

Saturated Playground Sand

Add water to playground sand until the surface glistens and no additional water can permeate the sand. The sensor should read a VWC of about 29% in Standard mode and about 60% in Soilless mode.

Note: WatchDog weather stations display the Standard VWC value. The soilless mode is available on the handheld reader only.

Sensor Calibration

Sensors with the “3/14” code printed on the front, (see diagram, p. 4) are capable of being re-calibrated with the soil sensor reader (Item 6466). The purpose of the calibration is to modify the output of the sensor so it gives an expected value in a known standard (distilled water). Basically, it returns it to the factory calibration. It does not make any adjustment that may be necessary to improve accuracy in non-standard soils (see **Soil Specific Calibrations** p. 12).

The calibration is done with the calibration screen of the soil sensor reader. For readers with firmware version 4.5 or higher, the top line of the calibration screen will read “CAL?”. For meters with firmware version 4.4, the top line will read “CAL EC?”.

Installation

The most important consideration for installing the sensors is maintaining good contact between the sensor and the soil. This ensures optimum performance.

Important: The sensor can be damaged if it is pushed directly into hard, native soil. Please read installation guidelines before installing the sensors.

Surface Installation

If the sensor is being installed near the surface such that the molding and cable will remain above the soil surface the sensor can sometimes be pushed directly into the soil. Because the sensor board is flexible, care should be taken to avoid snapping it during installation. Do not strike the sensor with a hammer or other blunt instrument as this could damage the sensor electronics. If the soil is very hard, a small slit can be dug into the soil with a knife or shovel to facilitate easier insertion. Subsequently, pushing that same implement into the ground surrounding the sensor will improve the contact between soil and sensor.

Deep Installation

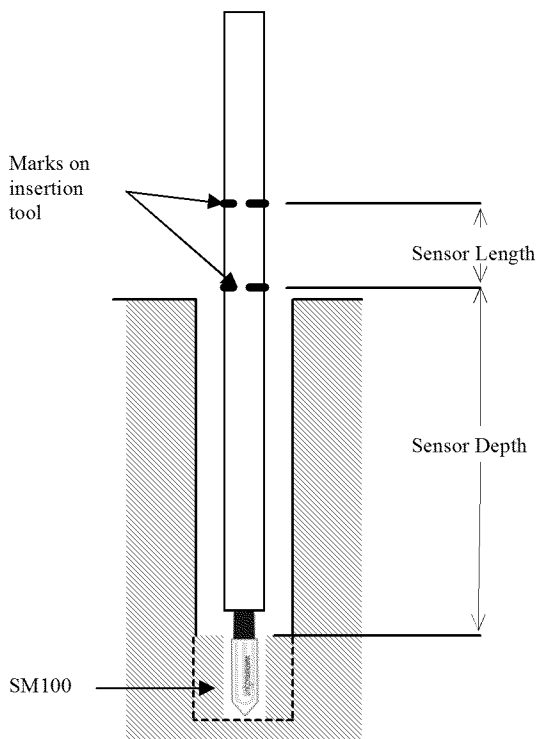
Vertical Orientation

To install the sensor in a vertical orientation, dig an access hole to the desired depth. This can be done with a soil sampler, auger or slide hammer. If possible, it is recommended that the hole be at a slight angle. This will reduce the effect of water channeling down to the sensor via the sensor cable.

The sensor blade is 3/4" while the molding is 5/8". Therefore, there is a small lip on either side of the molding. This allows the sensor to be installed with a pipe or tube. Any material that fits over the molding and butts up against the base of the sensor may be used. Some op-



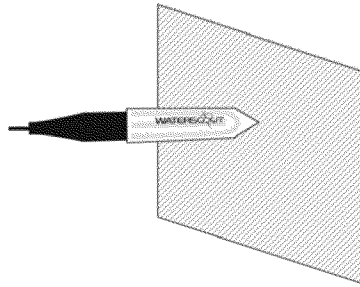
tions are ½" Class 315 PVC, ½" electrical conduit, or ½" Schedule 40 PVC. If the fit between the sensor molding and the insertion tool is excessively snug, a dowel rod can be used to ensure the sensor is not withdrawn from the access hole along with the insertion tool. In general, it is not recommended to push the sensor directly into native soil, especially in dry, high-clay or gravel/stone-laden soil. Instead, it is best to return some crumbled native soil from the bottom of the access hole, tamp it sufficiently and use the insertion device to push the SM100 into the packed soil. It is advisable to mark the tamping and insertion tools such that it is possible to determine that the sensor will be completely surrounded by tamped soil and that the sensor is being installed to the desired depth.



The access hole should then be carefully backfilled with native soil and tamped down to eliminate air pockets.

Horizontal Orientation

Digging a small hole or trench in the soil allows the sensors to be installed horizontally. The sensors are pushed directly into the exposed face of undisturbed soil. Because the sensor board is flexible, care should



be taken to avoid snapping it during installation. To limit the effect of water moving vertically through the soil profile, the sensors should be installed so the flat face is perpendicular to the soil surface. For the same reason, if sensors are installed at multiple depths, they should be offset from one another.

Removal

Care should be taken when removing a sensor that is firmly embedded in soil. Pull on the molding only. Pulling on the cable risks damaging the wiring.

Suggestions for protecting sensor cables from rodents

- For vertical installations, run sensor cables through PVC pipe. This can be the same tube used as an installation tool. If the sensor is attached to the pipe with an epoxy (such as Loctite® Acrylic Epoxy), it can more easily be withdrawn from the soil.
- For sensor cable that will be running parallel to the ground, either above or below the soil surface, the sensor cable can be fed through flexible conduit or drip irrigation tubing. When using drip irrigation tubing, it is preferable to use used tubing. This is because the tubing will have the curl taken out of it and will be easier to keep straight. A slit should be cut into the tubing with a box cutter and the cable pushed inside. If the cable and protective cover are not buried, they can be secured to the ground wire with hooks or turf staples.

Soil-Specific Calibrations

In some instances, greater accuracy is desired than can be obtained from a general calibration equation. In this case, it is necessary to perform a calibration on your unique soil. Essentially, a relation needs to be developed that relates the meter's electronic reading to the actual volumetric water content (VWC). This will require that some other method be used to measure the VWC.

Mineral Soils

VWC data can be measured in a lab setting by measuring the weight of a perforated soil column of known volume that is saturated, drained and dried. This method is preferred because the soil structure is not altered during the testing procedure. This procedure requires a weighing scale, a soil container with a height slightly greater than the WaterScout sensor (2 inches) and, depending on the ambient drying conditions, can take several weeks to complete. The procedure is briefly outlined below. WaterScout readings can be taken either with the Soil Sensor Reader or a WatchDog weather station. In either case, the device should be set to Raw AD or Raw Sensor mode.

1. Build a small container to hold the soil from a non-metallic material such as PVC. The sensitive volume of the sensor is not large so the container diameter does not have to be very big. In fact, soil-moisture gradients will form in the container as it dries so, unless several sensors will be used in the calibration, a small container will provide the best results. Cap the bottom of the container and drill holes in the cap and on the container's sides. This will allow water to permeate and drain as well as facilitate drying without allowing soil to spill or leak out. Drilling the holes at a slight downward angle will minimize spillage.

2. Measure the mass of the empty container and the sensor or sensors being used in the calibration.
3. Determine the volume of the container. This can be done geometrically or by measuring the volume of sand needed to completely fill the container.
4. Fill the container with air-dry, sieved soil.
5. Take a reading of the sensor in air, install the sensor in the dry soil, and take the air-dry reading.
6. Place the container (with sensor installed) in a larger receptacle and add distilled water around the OUTSIDE of the container until the water level reaches the top of the container. Allow the container to completely saturate. Take a sensor reading.
7. Transfer the container to the scale and measure the mass. It is advisable to have a tray to hold the container to keep water from spilling on the bench. Be sure to zero out the tare weight of the tray.

At this point, the procedure is to simply allow the container to dry while periodically taking simultaneous weight and sensor readings. Initially, the container will dry rapidly and 2 or 3 readings per day may be appropriate. As the container gets dryer, it will dry more slowly and the frequency of measurements will decrease. When the container returns to its air-dry value, the soil should be removed, oven-dried at 105 °C for 24 to 48 hours and allowed to cool in a sealed container before measuring the oven dry weight (ODWt).

The volumetric water content at each data point is calculated as follows:

$$1) \quad VWC_i = 100 * \frac{(m_i - m_{dry})}{(\rho_w * V_{tot})}$$

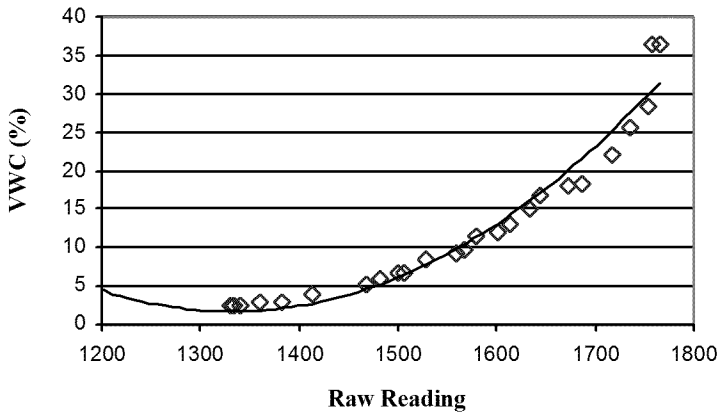
m_i = mass of soil at a given point
during drydown (grams)

m_{dry} = mass oven-dry dry soil (grams)

V_{tot} = total soil volume (ml)

ρ_w = density of water (1g/ml)

These calculations can easily be set up in a spreadsheet. The final step is to perform a regression between the raw data and the calculated VWC values. Regression analysis can then be performed on raw sensor data and the calculated VWC values to develop an equation to convert from measured readings to actual VWC.



A calibration curve can also be obtained by gradually wetting a pre-measured amount of soil with known increments of water. Care must be taken to return the soil to its original bulk density before a sensor reading is made.

Soilless Media

Because soilless media tend to be hydrophobic and have a tendency to shrink dramatically when very dry, wetting the material and allowing it to dry over time is not the ideal method for collecting data for a media-specific calibration. The recommended procedure is to establish different moisture contents by adding water to a known quantity of material and shaking or tumbling it into the soilless media. This is best done on a mass wetness (MW) basis where mass wetness is defined as:

$$2) \quad MW = 100 * \frac{M_{water}}{2 * M_{material}}$$

Where:

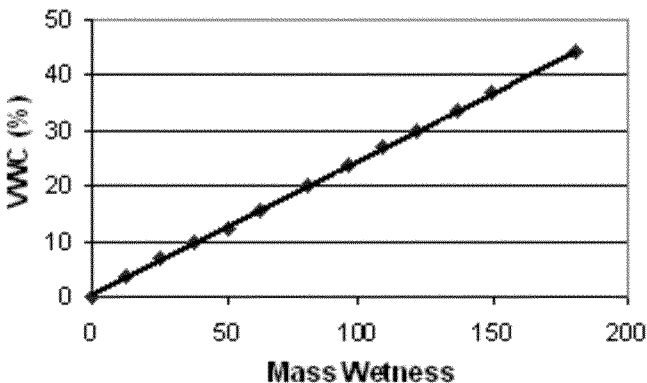
MW = target mass wetness (expressed as percent)

M_{water} = mass of water needed

$M_{material}$ = total air-dry mass of sample

We have found that, for sphagnum peat moss, the relationship between volumetric water content (VWC) and MW is on the order of:

$$VWC = 0.243 * MW + 0.5008$$



This can be used as a benchmark to determine your target MW values. If later you discover you've selected too narrow a range, this experiment can be repeated.

Calibration procedure

1. Acquire 18 containers with a diameter of 4 to 6 inches and a height slightly greater than WaterScout sensor (2 inches). This allows for 3 replicates at 6 different water contents. Commercially available pots should suffice. Containers can also be built from PVC.

2. Measure the volume and weight of each container. The volume can be found geometrically or by measuring the volume of sand needed to completely fill the container. Label each container. A convenient naming system would be to use a number to represent a water content and a letter to represent a replicate. For example, container 4B would be the second replicate of water content 4.

3. Starting with air-dry material, measure out 6 samples of soilless media. Each sample should be slightly more than is required to fill 3 containers.

4. Weigh the material and place it into a plastic bag. Establish 6 different water content conditions by mixing water into the air-dry material. Add enough water to bring the material to the desired MW. The needed amount of water can be determined by rearranging equation 2).

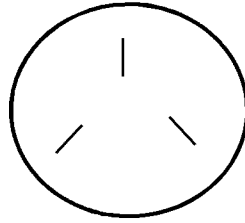
$$3) \quad M_{water} = 2 * \frac{MW}{100} * M_{material}$$

5. Twist or seal the bag so no material or water can get out. Shake the bag vigorously to incorporate the water into the media. For higher mass wetnesses, the water may be added in increments. After all the water has been added and shaken in, leave the closed bag to sit for, at least, 24 hours to allow the water and material to come to equilibrium.

6. Add wet material to the appropriately labeled containers. It is best to add the material in 3 increments, gently tamping each portion to the proper density.

7. Weigh each of the filled containers.

8. For each container, take three SM100 readings. Take care not to take readings too near the edge of the container. It is recommended to take readings perpendicular to the sides of the container. If using the handheld reader, the reader should be in Raw AD mode. If taking readings with a WatchDog weather station or mini-station, the channel the sensor is connected to should be programmed to the Raw Sensor option.



Suggested sampling locations

9. After taking the readings, completely air-dry the material in each container. DO NOT MIX the material from each container. Find the air-dry weight for the material in each container.

10. The volumetric water content for each container is calculated as follows:

$$VWC = \frac{M_{\text{wet-total}} - (M_{\text{dry-only}} + M_{\text{cont}})}{\rho_w * V_{\text{cont}}}$$

Where:

VWC = Volumetric water content

$M_{\text{wet-total}}$ = Total mass of container and wet material

$M_{\text{dry-only}}$ = Mass of air-dry material

M_{cont} = Mass of container

ρ_w = Density of water (1g/ml)

V_{cont} = Volume of container

11. You now have 18 VWC values (one for each container) and 54 raw readings (three for each container). A regression analysis can now be performed to relate raw value to actual water content.

Volumetric Water Content

The WaterScout SM100 measures volumetric water content. The volumetric water content (VWC) is the ratio of the volume of water in a given volume of soil to the total soil volume. At saturation, the volumetric water content (expressed as a percentage) will equal the percent pore space of the soil.

In-field soil moisture content will range from air-dry to saturation. However, plants cannot extract all the water in a saturated soil and can extract none of the water in an air-dry soil. Instead, two other moisture content levels, **field capacity** and **permanent wilting point** are often used to indicate the upper and lower limit of **plant available water**. Field capacity is defined as the condition that exists after a saturated soil is allowed to drain to the point where the pull of gravity is no longer sufficient to remove any additional water. Water draining from a soil profile cannot, in general, be taken up by plant roots. On the opposite end of the spectrum, permanent wilting point is the highest moisture level at which an indicator plant cannot recover turgor after being placed in a humid environment.

Irrigation should be scheduled somewhere between these two extremes. One rule of thumb is to apply water when half the plant available water has been depleted. However, individual circumstances may dictate a more conservative or liberal approach. Figure 1 illustrates the plant available water range for the 12 USDA-defined soil textures. Keep in mind that these numbers are merely guidelines and will vary for individual soils.

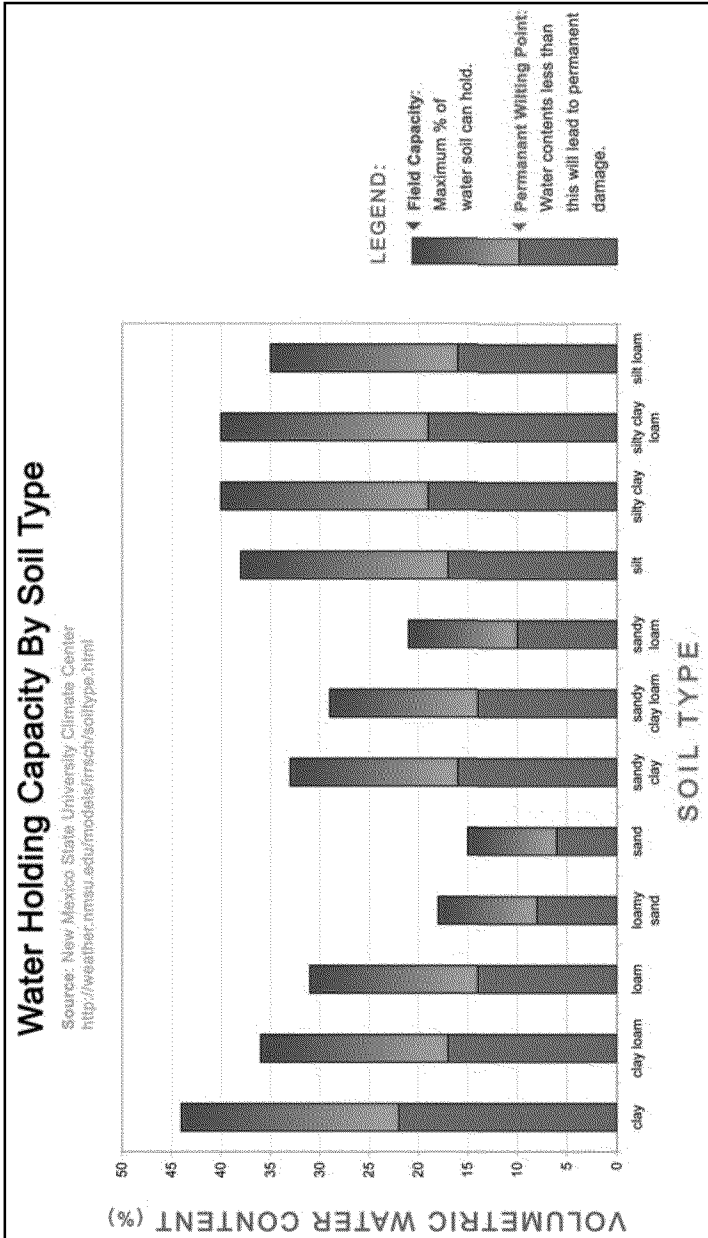


Figure 1.

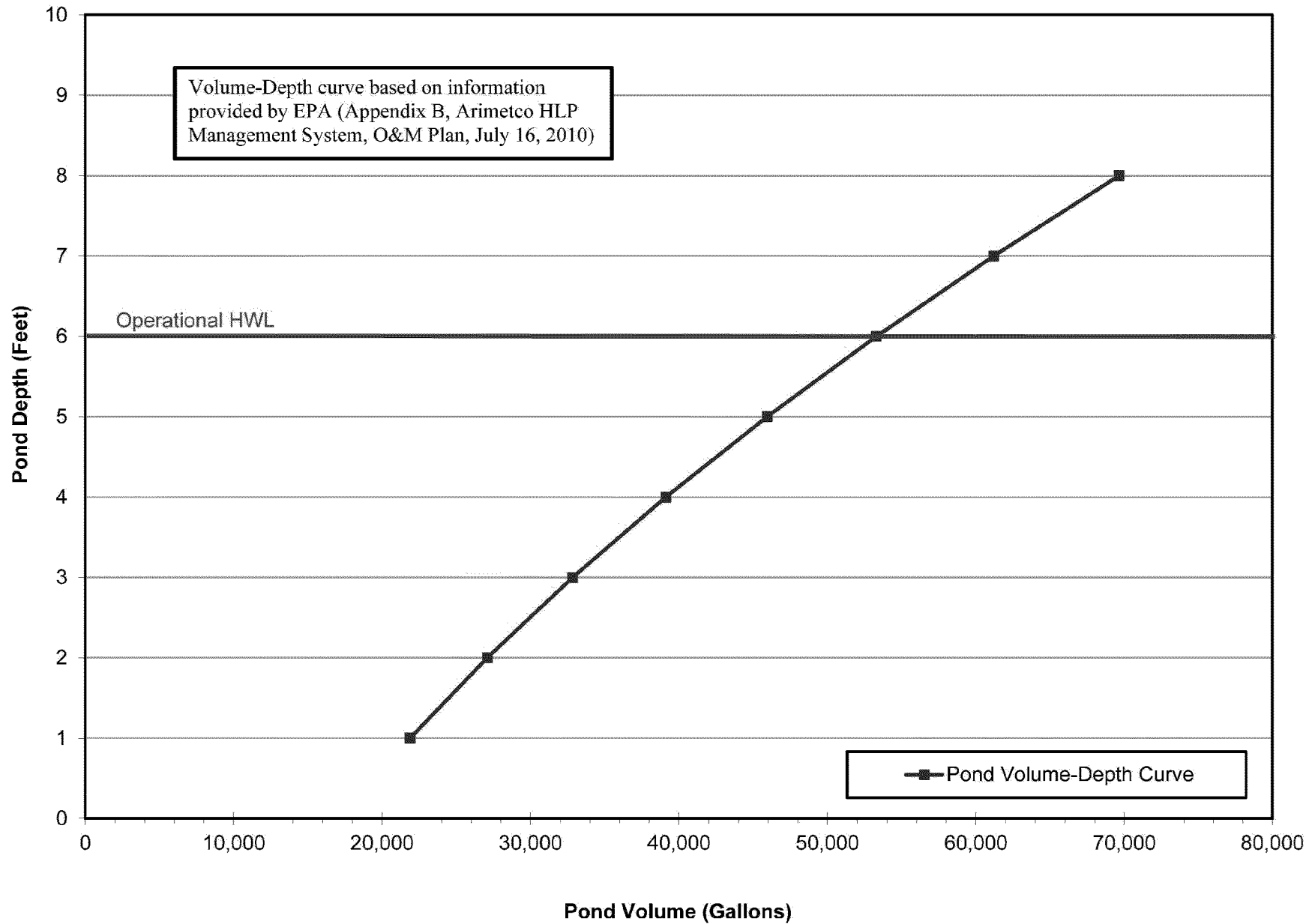
Warranty

This product is warranted to be free from defects in material or workmanship for one year from the date of purchase. During the warranty period Spectrum will, at its option, either repair or replace products that prove to be defective. This warranty does not cover damage due to improper installation or use, lightning, negligence, accident, or unauthorized modifications, or to incidental or consequential damages beyond the Spectrum product. Before returning a failed unit, you must obtain a Returned Materials Authorization (RMA) from Spectrum. Spectrum is not responsible for any package that is returned without a valid RMA number or for the loss of the package by any shipping company.

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Technologies, Inc.

**3600 Thayer Court
Aurora, IL 60504
(800) 248-8873 or (815) 436-4440
Fax (815) 436-4460
E-Mail: info@specmeters.com
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Appendix D FMS Pond Elevation vs. Capacity Curves



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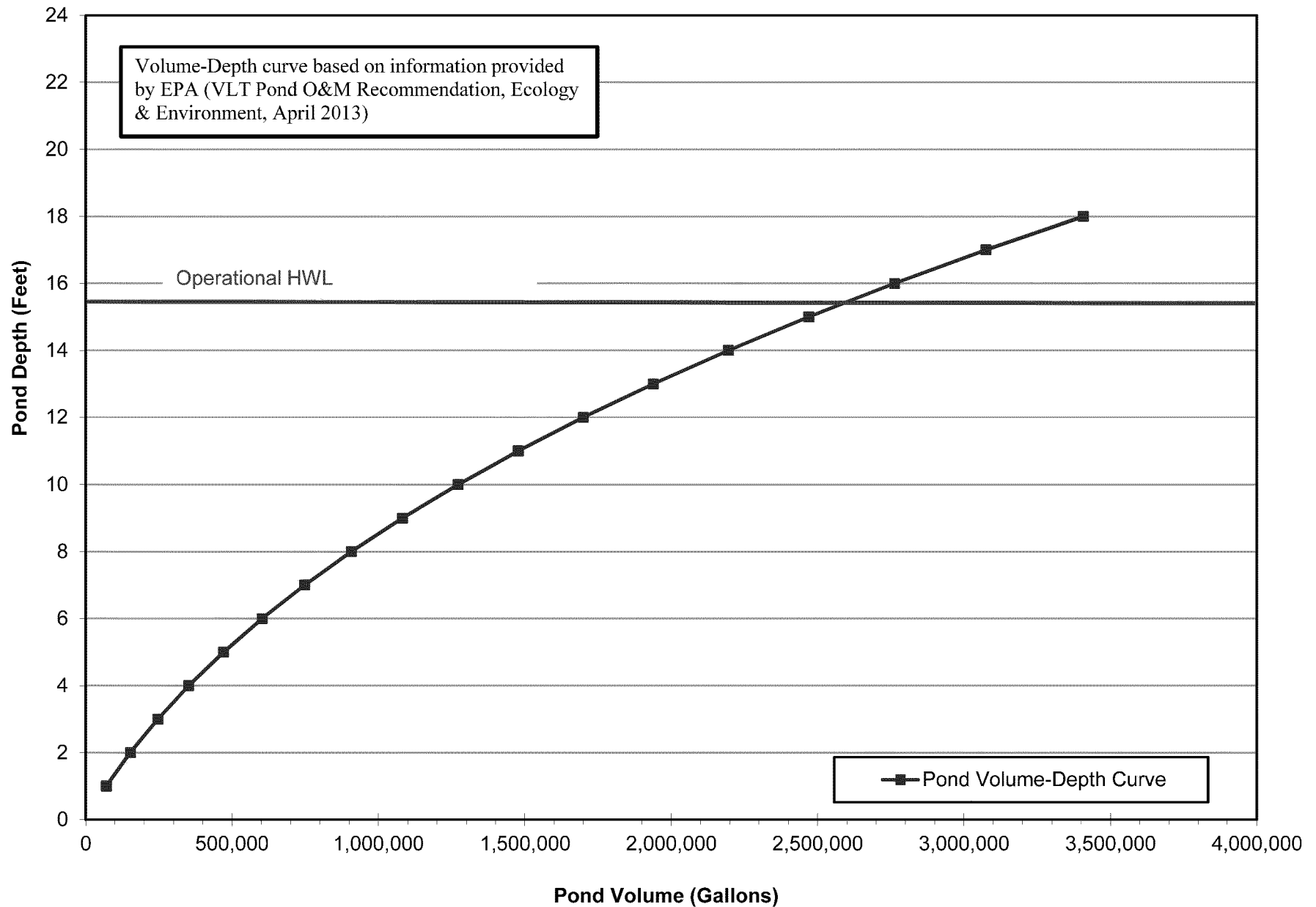
Date: Jan. 2015

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Project: 145482

**Yerington Mine
Site, Nevada**

**Figure 2-3
Arimetco
VLT Sediment Pond
Volume-Depth Curve**



**Brown AND
Caldwell**

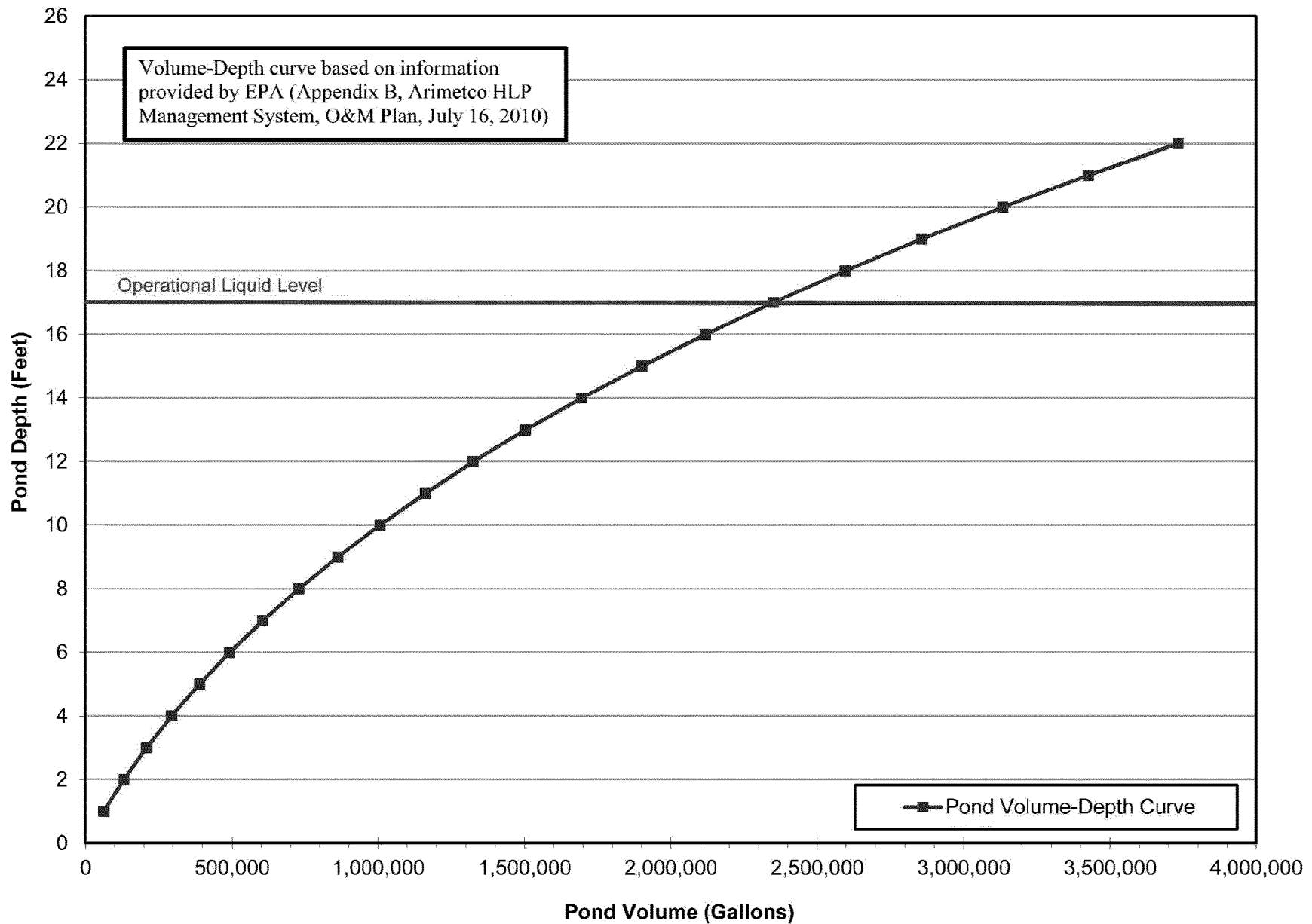
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Project: 145482

**Yerington Mine
Site, Nevada**

**Figure 2-4
Arimetco
VLT Storage Pond
Volume-Depth Curve**

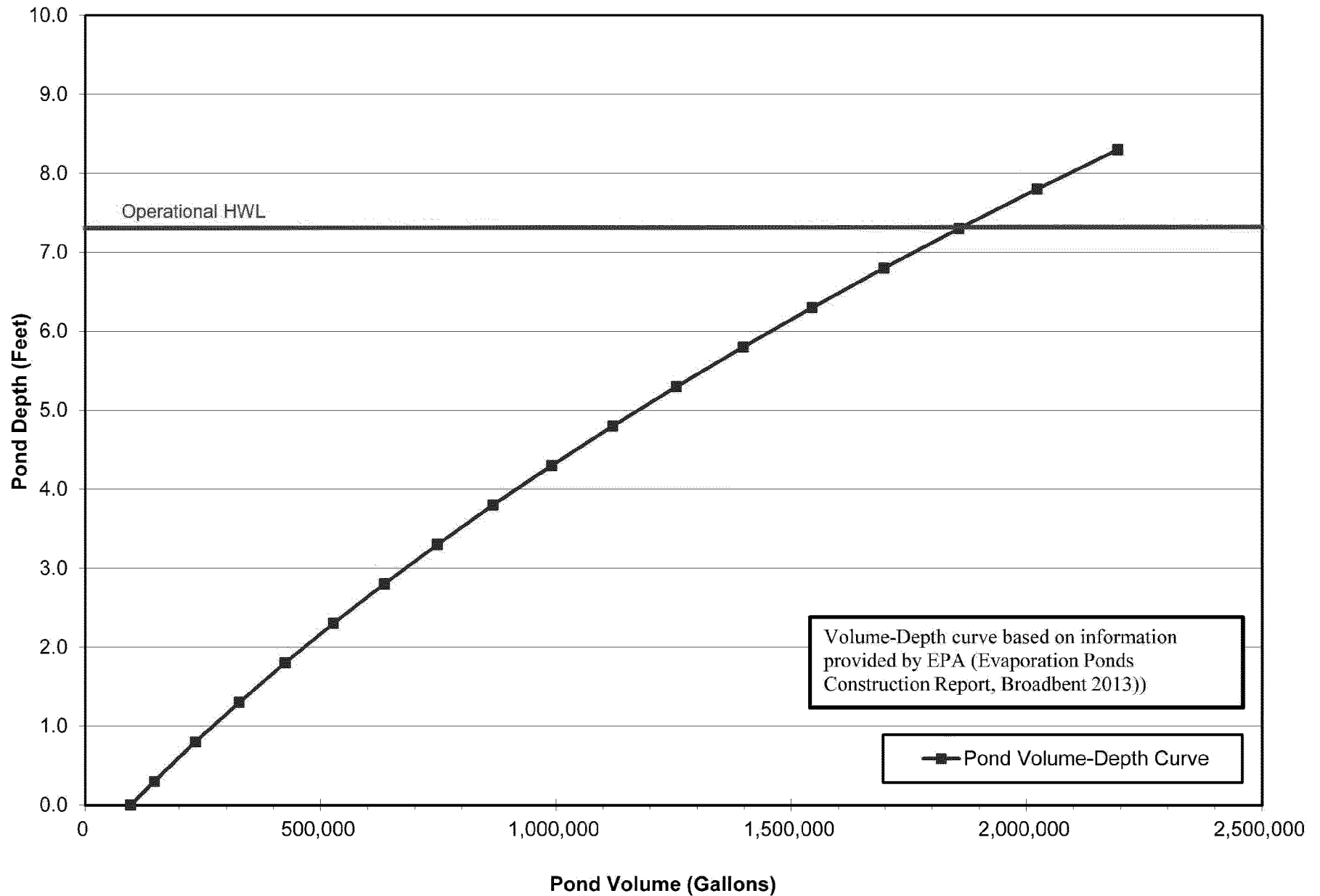


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**Yerington Mine
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**Figure 2-6
Arimetco
Slot Storage Pond
Volume-Depth Curve**



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**Figure 2-9
Arimetco
Evaporation Pond B or C
Volume-Depth Curve**